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The Growth of Electric Lighting. WE present on the next page some interesting statistics of the growth and extension of electric lighting in this country. It is a marvelous record, and one in which all who, like ourselves, have been actively engaged in making it, may well feel satisfaction. It is a cause of congratulation not only for the practical men who have done the work, but for the scientists who, struggling to arrive at clearer notions of electrical phenomena, have led the way to new arts and sciences, and have put in skillful hands the tools and means that have helped create the vast network and system that now lights so many thousand cities, villages, mills, foundries and industrial centres all over the country. There is too often shown a tendency to belittle the theoretical or to ridicule the investigator who pursues the truth for its own sake; but, after all, it is to such disinterested work that our great industry owes largely its present state of advancement, and while such work is not seen in the magnificent total of plants and lights, it is there, in the foundations of the whole fabric. In the same way, the work of electrical journalism is to be found in those returns, and the result has been that the pioneer toil of advocating a new industry is its own reward. The statistics we give of the growth of this journal show how it has kept pace with the industry, at each stage exemplifying by its own advance and enlargement the development and greater cultivation of the field.

Series Incandescent Lighting. MR. ALEXANDER BERNSTEIN has long been regarded as one of the leading workers in the department of series incandescent lighting, and we have had occasion from time to time to call attention to his work. This week we present the latest development of a system upon which he has been engaged for some time.

Preparing for the Convention. IT will be seen from the communications we publish in another column that great attention has been paid to the arrangements for transportation to Pittsburgh. Messrs. Porter and Bowen are entitled to thanks for the pains they have taken to insure the comfort of their friends attending the meeting of the National Electric Light Association, and their work should be appreciated.

Electric Railways. IT will be noted that electric railways occupy a prominent place in this week's issue. The innovations and improvements brought to attention are highly important, and show great advances in the art; while the record of the new roads equipping or going into operation furnishes evidence of the activity to be displayed throughout the year. Young electrical engineers cannot do better than qualify themselves for this field of work.

Dynamos in Telegraph Work. THE successful operation for a long period of time of the dynamo-generating plant in the Western Union building, in this city, shows conclusively that the dynamo machine can be relied upon for the most exacting service. It is also well worthy of notice, and to the credit of the original designer of that plant, Mr. Stephen D. Field, that the arrangement of the new plant is practically identical with that of the old one. The article begun in this issue on the subject, by Mr. Wm. Maver, Jr., will be found of great interest.

Schools of Telegraphy. MAYOR HEWITT has entered upon a crusade worthy of his zeal and ability. He is now directing his energies to the suppression of telegraph schools. He cannot hit upon any means of reaching them by the law, and therefore proposes to keep a policeman before the door to warn off unsuspecting young men and women who expect to qualify in six months for positions paying $1,500 a year. He now has in his possession a list of ten students swindled at one place uptown. The Mayor has our heartiest good wishes in this work, and is entitled once more to public support.

The Hydraulic Dynamometer. WE describe in this issue the decidedly novel dynamometer designed by Herr Von Hefner Alteneck, in which the hydraulic principle of the transmission of pressure is employed as the governing principle. The objection which naturally arises with regard to the use of such a dynamometer is that the sensitiveness of the apparatus would be greatly impaired by the friction between the parts upon whose movements the accuracy of the indications depend. But, on the other hand, it is interesting to know that Herr Von Hefner Alteneck considers this objection a very small one. His experience shows that friction between bodies has no permanent influence upon their ultimate relative positions if the two bodies be kept in motion, or subject to the influence of jarring or vibration. The criticism is quite analogous to the objections which have been raised to the employment of gears and pinions in electrical indicating instruments; and it is well-known that several makers of instruments have discarded the use of gearing in apparatus of that kind.

Electric Lighting in Factories. A VERY interesting correspondence has lately been carried on in the columns of the *Manufacturers' Gazette* as to the cost of electric lighting. The general tenor of the letters is very satisfactory to all who believe in the superiority of the electric light. Our contemporary remarks: "Many users of the electric light write that their dynamos, being driven from the prime motors direct, there is seen no appreciable difference in the amount of coal burned since the light was installed. Some writers state that their electric lights cost less than gas at prices varying from $1.25 to $3 per 1,000 feet. Nearly all the firms of which inquiries have been made state that the electric light gives much better satisfaction than gas. Electric light wiring cannot be set down as costing so much per light of so many candle-power, until a most careful examination and calculation has been made, the premises fully canvassed and plans drawn. Of all engineering, that relating to electric lighting offers the least inducement for 'office engineers,' who wish to do their work on paper at a distance." Emphasis is laid upon the necessity for careful wiring with good wire, and it is noted that a good non-oxidizable lamp fixture for paper mills and like places is a desideratum.

Alternating Current Motors. THE subject which Dr. Louis Duncan will bring before the American Institute of Electrical Engineers at its meeting next Tuesday evening is one that may well occupy the attention of that body, as it constitutes one of the principal problems in the utilization and the progress of the alternating system. The increase in the output of central stations operated by the direct current caused by the intercalation of motors upon their circuits, is sufficient indication of the fact that if the alternating station is to be utilized to its full capacity, the alternating motor must be present. At previous meetings of the Institute participants in the discussions have stated that this problem has been attacked, with the result of leading to the construction of several types, which have given good results, and we consequently hope to obtain more detailed information with regard to these machines, as well as their manner of regulation, for maintaining synchronism with variation in the load. It has frequently been brought forward as a drawback to the introduction of the alternating system, that it lacks the qualities of a source of power for commercial purposes. But if it shall be shown presently that this ground is no longer tenable, the chief remaining criticism on the alternating system will be that it is unfit for electrolytic purposes. And we may add that even this has recently been denied, or, rather, the contrary affirmed.

Electric Sunstroke. AN item is going the rounds of the press as to the alleged wonderful effects of the electric furnace employed at the Creusot foundry in France for the melting of steel. It is said that persons standing at a distance of but a few yards feel no heat, yet the spectator who remains for an hour or two experiences a burning sensation, with more or less pain in the neck, face and forehead, the skin at the same assuming a coppery red tint. The later symptoms are headache, sleeplessness, etc. As the presence of heat is not detected, the conclusion formed by many is that the result of the exposure is similar to that of a sunstroke. But the effect here noted is probably an old story to those who have been engaged in the testing or construction of arc lamps when a large number of the latter were burning at one time. We may consider the effects produced to be a combination, in fact, of several causes, which, acting altogether, due to a large number of lamps in a confined space, would bring about the symptoms noticed. We have in the first place the induced action of the arc upon the retina of the unprotected eye, which reacting upon the nervous system would cause some of the bodily ills referred to. If, in addition to this, we add that in a confined space, considerable quantities of ozone and nitrous oxide, both powerful oxidizers, are produced, the other facts observed can also be explained. Hence we may have all these phenomena explained, without the presence of heat as the superior inducing cause.

Alternating Currents and Contiguous Wires. THE discussions which have taken place in this country on the effects of circuits carrying alternating currents upon neighboring conductors have left out of consideration to a certain extent the influence of such circuits with respect to the loss entailed by induction between wire and wire. This question is brought up by a correspondent, in another column, who seems to fear the loss which will ensue by induction between an alternating current circuit and a continuous fire alarm wire. The case presented is in some respects similar to the frequent question of the effect with telephone wires. As pointed out, there is in both of these cases nothing to fear from induction, and, hence, no loss, if the outcoming and incoming alternating circuits are placed quite distant from the third wire. Any induction caused by one side of the circuit is neutralized by the induction of the other. But, it may be asked, what is the effect of the induction caused by one branch of an alternating circuit when contiguous to the other, and here is a question which we think will bear investigation. It seems to be plain that, other things being equal, the two branches of an alternating circuit ought to be separated some distance in order to avoid loss by self-induction. Such effects, it is true, only become marked when two wires are placed close to each other over a long distance, but there is sufficient here, it seems, to be taken into consideration in the laying out of alternating current systems of wiring, especially when underground work is attempted.

NEW BOOKS.

A COURSE OF LECTURES ON ELECTRICITY. By George Forbes, M. A., F. R. S., etc. London and New York: Longman, Green & Co. Illustrated. 5 × 7¼, pp. 168. Price, $1.50.

The work comprises a course of lectures delivered before the English Society of Arts, and a special lecture delivered at the International Electrical Exhibition at Philadelphia in 1884, in the series organized by the Franklin Institute. These addresses were therefore delivered to appreciative and intelligent audiences and are well worthy of their present revision and publication. Prof. Forbes is one in whom the gift of clear exposition is combined with a very thorough mastery of electrical science, and every page of the book is luminous and helpful. We are convinced that such works have an important place to fill and are very glad when their preparation falls, as in this instance, to excellent hands. We believe there are many in the electrical field who will read the lectures through with pleasure and profit, while a great many more, now unfamiliar with the science, will be attracted to its further study. The illustrations are numerous, unhackneyed and good, but the book would be the better for an index.

The Growth of the Electric Light Industry.

The fact that the Edison Association meets this week in Chicago and that the National Electric Light Association meets a fortnight hence at Pittsburgh, calls attention again to the remarkable development of the electric lighting industry in this country. These two bodies represent a business growth which is believed to be without parallel, and whose influences are of the most pronounced and far reaching nature. A glance at the statistics will be of interest.

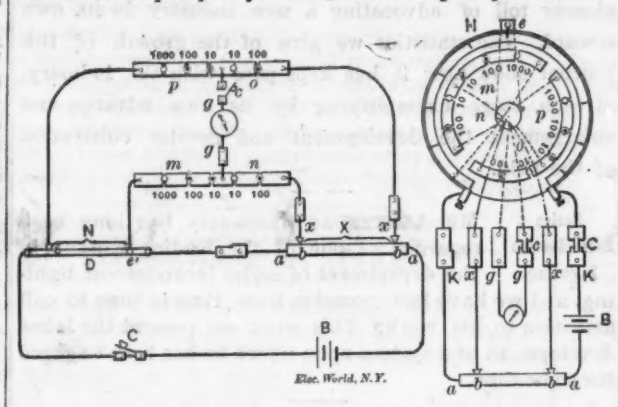
At the beginning of 1886 about 450 local lighting companies had been established by various parent companies to the number of between thirty and forty. During 1886, the number of new local companies, by actual count, was over 300. The same rate of increase was maintained last year, while many gas companies entered the field during the period, bringing the total at the present time up to 1,000 in round numbers. There have been many companies projected that never came to anything, and there have been many consolidations, but the outcome of the work done is that at least 1,000 central stations are now running in this country. Some idea of what this means may be formed from the contrast presented by England, where a month or two ago there were 17 central stations in operation

In 1886 there were, by authentic statistics, counting plant by plant, 1,000 incandescent isolated plants, and not quite as many arc, in the United States. If, therefore, there had been an increase of only 1,000 plants of both kinds since that time, the total of isolated plants to-day would be at least 3,000.

The grand total thus arrived at is 4,000 electric lighting plants in this country—a figure which may safely be accepted as near the actuality, and, if anything, below it. When it is remembered that some of the parent companies have facilities for turning out from 30 to 40 dynamos per week, with lamps to match, it will be seen that these totals, so enormous, do not represent, after all, a very heavy strain on the productive capacity of the business, on its manufacturing side.

The number of lamps burning in connection with these plants has been variously estimated, but in no case do the figures depart very widely from 200,000 arcs and at least 1,250,000 incandescents. Of the arcs about 150,000 are credited to the central stations. Incandescent lighting has hitherto found its largest application in isolated plant work, but at least 500,000 incandescents may be put down as operated from stations. The figures of two leading arc light parent companies alone give upward of 80,000 arcs; and the figures of two leading incandescent companies mount toward 1,500,000 incandescents. It will thus be apparent that the totals are very conservatively stated. In fact, the tremendous rapidity of growth of itself discourages exaggeration, and at the present the extension of the alternating system, the use of incandescents on arc circuits, and the general introduction of motors are giving a development to the industry that was undreamt of twelve months ago. There are indications that incandescent lighting has now a higher rate of growth than the arc.

The effect on allied industries has been, as already said, of the most marked character. Its stimulus to the steam engineering branches is familiar to all. It has increased the product of wire many times over. It has called into being the two industries of arc carbon and incandescent lamp manufacture. According to the estimate of President Graves, of the English Society of Telegraph Engineers and Electricians, in his recent inaugural address, electric lighting gives direct employment to at least 100,000 workers. Mr. Graves also commented on the striking advance of the electrical press as caused by the later outgrowths of the art. A few figures from the development of THE ELECTRICAL WORLD give force to his remark, and may, perhaps, be here cited. In 1883, the year in which the electric lighting industry took its first great stride, the paper contained a total of 853 pages. Last year it had more than twice as many pages of the same size—that is, no fewer than 1,730. The actual amount received for papers, from sales and subscriptions, increased 43¼ per cent. in 1885 over 1884; 29⅛ per cent. in 1886 over 1885, and 32 1/17 per cent. in 1887 over 1886, while the percentage for 1888 is higher than any before attained. In the first issue of 1883, the paper contained 63 regular paid advertisements. In the first issue of 1887 there were 154 such, and in that of 1888 there were 175. The figures of the paper for the whole of its career of fourteen years would, of course, furnish other very interesting comparisons, but it will suffice to limit them to the period in question, that which embraces the growth of the electric lighting industry. The newspapers of a city are frequently regarded as exemplifications of its prosperity. They have helped promote its welfare, and bear the impress of, as they serve to impart, its characteristics. In the same manner technical journals reflect and assist the advance of the sciences and arts with which they are connected.



FIGS. 1 AND 2.—BRIDGE FOR MEASURING SMALL RESISTANCES.

Thomson Bridge for the Measurement of Small Resistances.*

Messrs Siemens and Halske have in process of manufacture a bridge of the pattern devised by Sir William Thomson, and especially designed for the rapid and accurate measurement of small resistances. The chief value of this arrangement lies in the fact that the influence of the spurious resistances due to the contacts with the conductor of the low resistance is entirely eliminated. The conductor whose resistance is to be measured is balanced against an arm of the bridge whose resistance is of the same order; but the resistance of the remaining branches of the circuit (which are in series with one or other of the four *contacts* of the low resistance conductors) are of a higher order, and hence these contact resistances are negligible. The bridge in question is adapted to the measurement of resistances varying from 0.1 ohm to 0.000,001 ohm. Fig. 1, which we reproduce from the London *Electrician*, shows the diagram of the connections. The principal circuit is made up of the battery *B*, the key *C*, a conductor *D*, and the resistance *X*, whose value is to be determined. Two points *e e'*, in the conductor *D*, and two points *b b* at or near the extremities of the conductor *X*, are respectively connected with a pair of resistance boxes, as shown. The galvanometer bridges the circuit between the two arms of the resistance boxes.

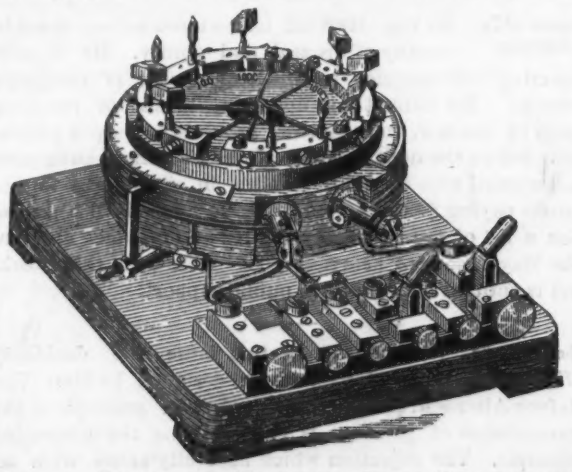


FIG. 3.—BRIDGE FOR MEASURING SMALL RESISTANCES.

If the total resistance in the branch m = that of branch n, and likewise $o = p$, there will be no current in the galvanometer, and then

$$X = N,$$

where N equals the resistance of conductor D between the points $e\ e'$.

This resistance N can be varied within limits by sliding one of the contact pieces e. In this way resistance can be measured whose value is at the maximum not greater than that of N. If the resistances N and X are very different, the resistances m, n, o, p are adjusted so that

$$\frac{n}{m} = \frac{o}{p}.$$

We have then $X = N\frac{o}{p}$, and the value of X as read by the slider has simply to be multiplied by a decimal constant. In the instrument of MM. Siemens and Halske, which is shown in Fig. 2, the conductor *D* consists of a circle of palladium, which is fixed upon a wooden block. The circle is finely divided at the margin. The sliding contact *e* is made by a movable arm pivoted at the centre of this circle, and provided with a vernier for accurate reading. The contact *e'* is fixed.

The plug contacts of the resistance *m*, *n*, *o*, *p* are arranged around the same circle. The terminals for the remaining connections are placed upon the front of the base board, and the manner of joining up will easily be seen on comparing Fig. 3 with Fig. 1, in both of which the same lettering is employed. Flexible wires are connected to the points *x x* for joining up the resistance to be measured.

As an example of the employment of the apparatus, suppose that $n = 10$, $m = 1{,}000$ and $N = 0.0051$, we should then have

$$X = 0.0051 \times \frac{1}{1{,}000} = 0.000051 \text{ ohm.}$$

This new model of the Thomson bridge is a very practical piece of apparatus, and will unquestionably be extremely useful in facilitating the measurements of minute resistances.

* From the *Electrotechnische Zeitschrift*.

Electric Organ Actions.*

BY G. WACKER.

As far back as 1860 experiments were made to operate the key-stop and draw-stop valves of organs by electricity. The simplest way to accomplish this end, and the one that has been followed by some up to the present day, would seem to be to employ, besides the necessary connections with the keys and draw-stop knobs, the common U-shaped electro-magnet with a pivoted or hinged armature, substantially the same as that in a regular telegraph sounder; and to connect this armature directly with the valve to be operated. But as the distance between the armature and the magnet poles must in this case be somewhat large, and as the power necessary to open the valve is greatest at the beginning of the motion, when the armature is farthest from the poles, and owing to the pressure of the compressed air on the valve, it follows that this method requires very large electro-magnets and an amount of current which alone makes its practical application an impossibility.

The interposition of pneumatic levers between the magnets and the valves brings the matter nearer to practicability, as the initial power necessary to operate the valves of those levers is comparatively small, and the motion of the valves is also very short, so that smaller magnets can be used, and the motion of the armatures reduced, resulting in a great saving of current. But a magnetic circuit being established between the poles in this and similar forms of magnets, there results a retention of the armature for a short time, due to residual magnetism. Hence after the current is broken it becomes necessary to employ a retraction spring on the armature, which in turn calls again for a somewhat increased current to overcome its additional resistance.

Having finally balanced and regulated all those things, it is of the utmost importance to let each magnet have only a certain exactly determined amount of current; any perceptible difference would nullify such a balancing and impair the proper working of the whole arrangement.

Such an exact distribution of current in an organ action is not as easy a matter as it would seem, because the external resistance varies in a manner not found in any other application of electricity, ranging in various amounts from about 30 ohms to almost a short circuit in the most rapid succession, according to the number of keys and draw-stops operated at the same time. Adding to this, further, the not infrequent binding of the several parts, even in spite of the most careful adjustment, it will be understood that it is an impossibility to make a successful organ action or one reliable even for a short time with this form of magnet.

This fact, coupled to another one not less true and not less important, and of which proofs are only too abundant, namely, that of all those engaged in this work there was hardly one familiar with the laws relating to current, electromotive force or resistance, and it is not surprising that the electric organ action from a practical and business standpoint was for a long time not much short of a failure.

Having made experiments in this line myself as early as 1867, and with interruptions up to the present day, I came to the conclusion long ago that, to make the thing a success, I must find a magnet which does not require any springs or other regulating devices, which has no parts liable to bind, and which is simple in construction and reliable in its working. This magnet, the ideal one for the purpose, I think, I finally found at last some years ago. Its core is a straight hollow cylinder, having an armature movable in the line of its axis. The core is inserted into one end of the coil to about one-half its own length, and to about three-quarters the length of the coil. Into the other end of the coil the armature is inserted, being of smaller diameter than the core, and thus leaving an annular space between itself and the coil. This armature is not connected to anything, but moves entirely free, governed only by the attraction of

* Abstract of a paper read before the Polytechnic Section of the American Institute, Jan. 26, 1888.

the core and its own gravity. As will readily be understood. a current sent through the coil will not magnetize the core only, but also the armature, both facing each other with poles of opposite polari y inside the coil, while the projecting ends of both form the other two poles, also of opposite polarity. These four poles, being in a straight line with one pair at the distant ends. the formation of a magnetic circuit is avoided, while the attraction of the two poles inside the coil is, at least, as great as in the form of the horseshoe magnet. If such a magnet is placed vertically, with the core uppermost. and a current sent through it, the armature will be drawn upward ; when the current is broken it will drop by its own gravity.

As sensitive as this magnet is in point of power it is not at all sensitive in regard to the amount of current sent through it; it works equally well with a current of 50 volts potential as it does with one of 3 volts; this. however, is not its only advantage. Supposing the armature to be resting on a non-magnetic tube of suitable dimensions, it will close the upper end of this tube ; now, if attracted by the core. it will open it, but in turn close the lower end of the tubular core. and *vice versa*. By establishing a third conduit leading to the annular space around the armature we have all the elements of a perfect three-way valve. If the magnet is placed horizontally the working is substantially the same, except that in this case the armature will rest where it has been drawn by the attraction of the core after the circuit is broken ; to bring it back in its initial position a second coil and core is provided at the other end. This form I use for the draw-stops: here the current is automatically interrupted as soon as the stop is on. or off respectively, thereby saving all the current that would flow through it while that stop is in use.

As will be seen from the above, I did away in this manner with all the valves, valve-stems, springs, pivots, regulating screws, etc., substituting for these an arrangement doing all that is required and in a much better way than ever done before, and having only a single movable part, the armature, not connected to anything and the motion of which never exceeds a $\frac{1}{16}$ of an inch.

The velocity with which this arrangement works far exceeds the practical requirements of an organ action, ten openings and closings of the valves per second being easily obtained. There are a number of large organs now equipped with this action and in no instance has it given any trouble whatever.

The French Cables.—The French Cable Company has given notice of an appeal from the decision of the Tribunal of Commerce, which gave a verdict for the Anglo-American Cable Company in its suit against the French Company for failing to carry out its agreement with the pool.

The Bentley-Knight Electric Railway System.

We illustrate on this page the standard Bentley-Knight motor truck as it appears before the car body is mounted. It is entirely independent of the car body, and can be put under any existing car without cutting or alterations, and without lifting the car above its normal height. The motor is controlled from either end of the car, the only connection necessary being a chain attached to the ordinary brake spindle. By this arrangement the whole control of the car is from the ordinary handle. Turned in one direction, it throws off the brake and starts the car, while, turned in the opposite direction, it stops the car and applies the brake. The weight of the motor is concentrated on the driven axle, so that the tractive adhesion is ample at all times. The motor has a spring support. so that wear on working parts and on the track is very light, while it also permits a yielding impact of the motor on the load at starting.

Tooth gearing is used throughout and all journals are held in rigid cas ings. The gearing is guaranteed to be noiseless, efficient, reliable and durable. The brakes are hung from the truck, not from the car body, and there is, therefore, no jarring felt by the passengers when brakes are applied. The motor has been designed especially by the Thomson-Houston Electric Company, and has already been illustrated and described in our columns. The com-

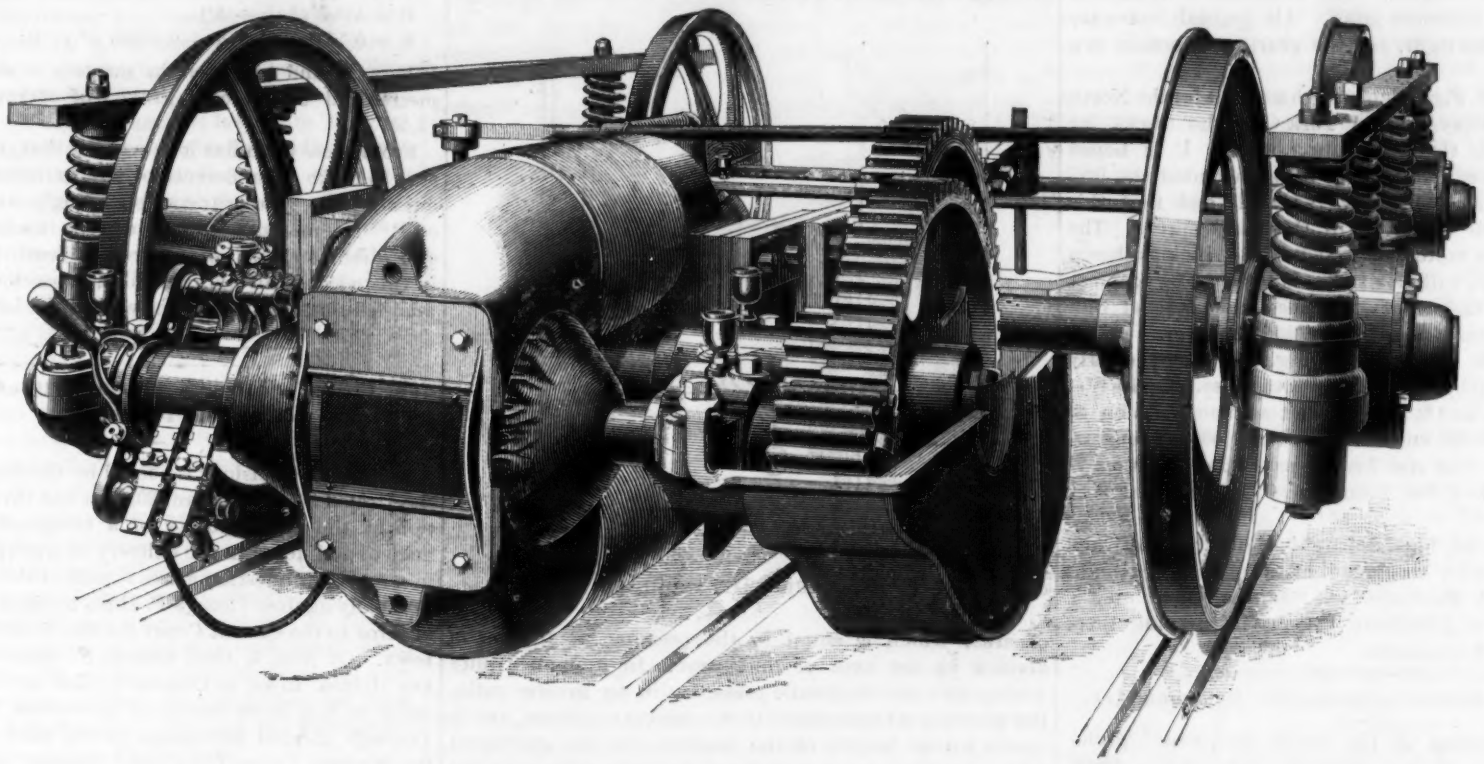


FIG. 1.—TRUCK OF BENTLEY-KNIGHT ELECTRIC STREET CAR.

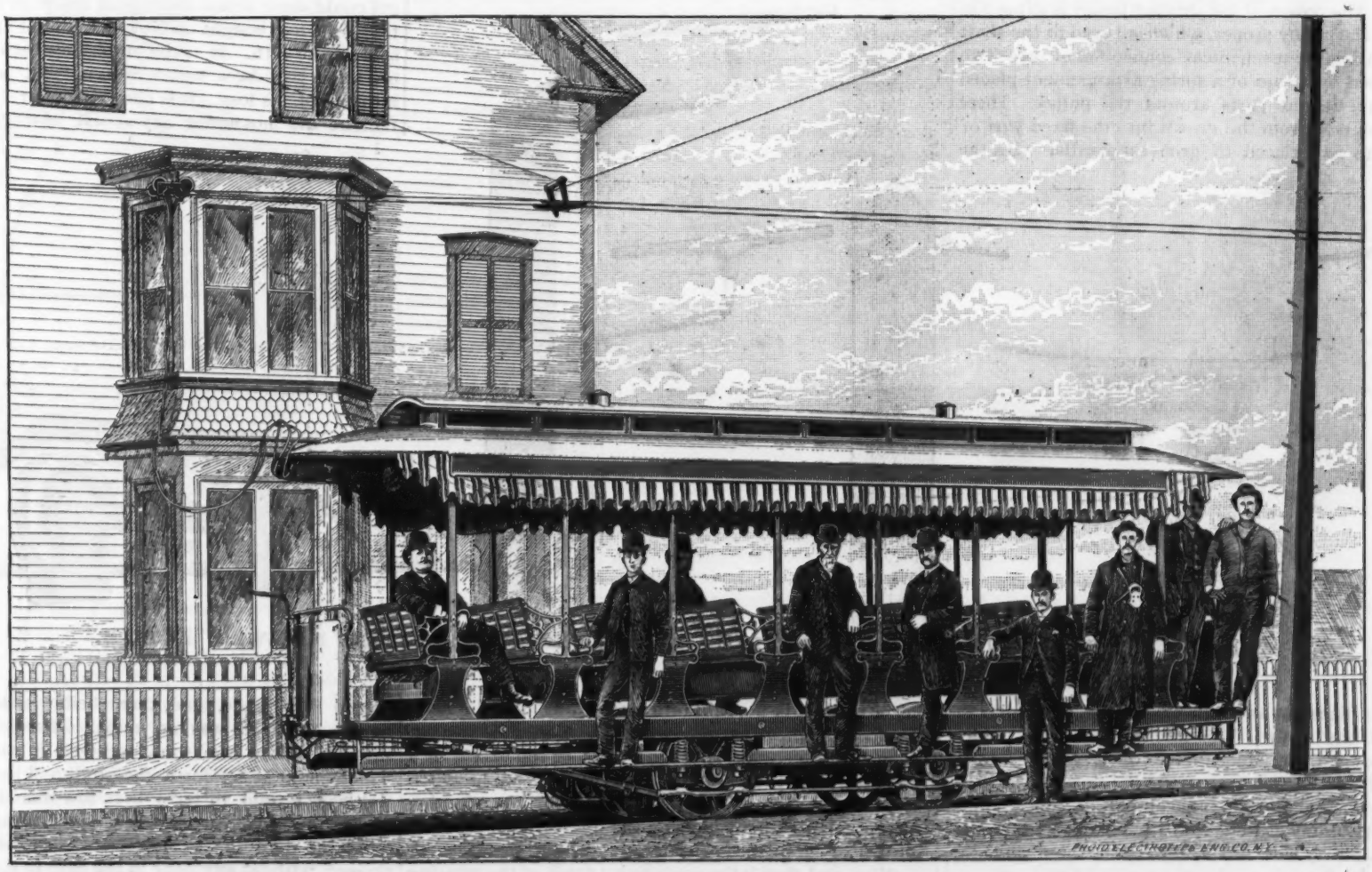


FIG. 2.—VIEW ON BENTLEY-KNIGHT ELECTRIC RAILWAY, WOONSOCKET, R. I.

mutator brushes are fixed in position, and need no adjustment, either for change in load or direction of rotation. The motor, therefore, requires but slight attention, and can be put under the car with perfect safety. There is no flashing or sparking under the heaviest load. But one set of commutator brushes are used, and they are adapted for either direction of rotation.

There is no heating of the motor, as it has but one layer of wire on the armature and but a small amount of coarse wire on the field magnet. The armature is incased in oiled silk and is moisture-proof. All journal boxes are self-oiling and dust-tight, and the gearing is incased in a dust-tight boxing.

The truck shown, Fig. 1, is one of those built for the North & East River Railway, of New York City, the tracks for which are now laid through Fulton street. It is hoped that the legal obstructions which have prevented the laying of conduit will be shortly removed, and that this road will be in full operation in the early spring. The Thomson-Houston motor, mounted on the truck as shown in the illustration, will give from 15 to 25 h. p. economically. The very heavy curves, grades and traffic of Fulton street necessitated ample provision of power.

The illustration of the car, Fig. 2, shows clearly the space taken up by the motor in actual use. On its first trial trip this car ran 13½ hours on a total consumption of coal of 1,680 pounds and carried over 1,000 passengers. It has drawn two full size loaded passenger cars up a 7½ per cent. grade and has been timed up to a speed of 28 miles per hour.

Other illustrations, Figs. 3, 4 and 5, show the trolly and overhead conductors employed by the Bentley-Knight Company. Fig. 4 illustrates the "hanger" used on the company's road at Allegheny City, and carrying there about five miles of conductor.

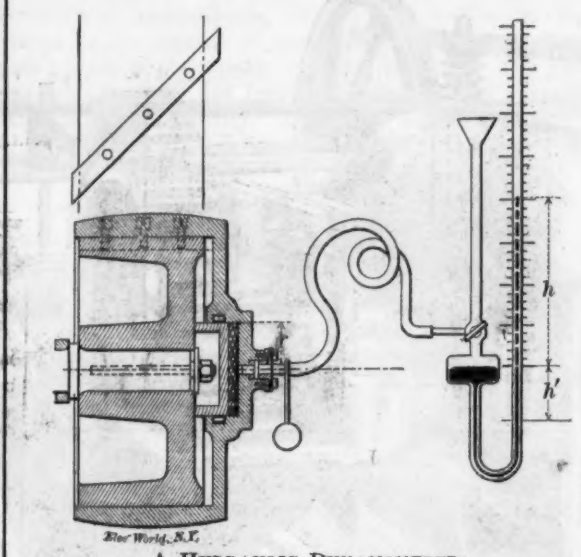
Von Hefner-Alteneck's Hydraulic Dynamometer.

At a recent meeting of the Berlin Elektrotechnische Verein, Herr von Hefner-Alteneck described a dynamometer employed by him in testing dynamos in the works of Siemens & Halske, in which the power transmitted was measured by hydraulic means. The speaker first drew attention to the ordinary forms of transmitting dynamometers, in which the difference of tension of the two sides of the belt was employed as a means of measuring the power transmitted. But he claimed that his hydraulic method gives more exact results, and has other advantages over the old methods.

The principal part of the new apparatus consists solely of a change of the driving pulley, the diameter, however, remaining the same. This is shown in the accompanying illustration. The crown of the driving pulley is slipped as a sleeve over the pulley proper, which is keyed to the shaft in the old way. The mechanical connection of these two parts is effected by means of a spring arrangement placed upon four equi-distant parts around the pulley. These springs, which pass from the crown into the fixed part of the pulley, are not placed in grooves parallel with the shaft, but are placed at an angle of 45 degrees, similar to the thread of the screw. The fixed part of the pulley therefore presents the appearance of a four-threaded screw, and the crown acts as a nut to the same. The consequence of this is that any force acting on the circumference of the pulley at the same time tends to turn the crown of the pulley sidewise in relation to the fixed core; in other words, it tends to give the crown of the pulley a motion parallel to the shaft. The direction of the screw upon the fixed pulley is such that this shifting of the crown takes place in a direction toward the machine. The crown of the pulley is closed in front by a web which has a cylindrical depression in the centre, into which fits a hollow piston which butts against the side of the fixed pulley. The piston is packed, as shown, in the method usually employed in hydraulic presses, rings of leather being used for that purpose.

The space between the end of the piston and the outer web of the crown communicates by means of a rubber tube with an ordinary mercury pressure gauge. At the point where the tube leaves the pulley, a stuffing box is provided which prevents the tube from turning at that point. The space included between the end of the piston, the tube, and up to the surface of the mercury is filled with a relatively light fluid, glycerine being preferable, which may easily be accomplished by means of the 3-way cock shown.

From the foregoing it is clear that the driving power of the belt is transmitted to the liquid contained between the end of the piston and the outer wall of the crown pulley. According to the well-known hydraulic law, the inclosed liquid exerts a pressure in all directions per unit



A HYDRAULIC DYNAMOMETER.

of area, which is equal to the pressure of the piston divided by the area of the piston. In a manner quite analogous to the hydraulic press, but in an inverse ratio, the pressure is transmitted to the mercury column, and is shown by the height of the mercury in the graduated tube. Leaving out of consideration certain influences, the power measured is proportioned to the height of the mercury.

It might be objected by some that, with the mechanical construction employed, the friction at the screw surfaces and at the piston might diminish the accuracy of the apparatus. Herr von Hefner-Alteneck, however, states that it has been his experience that friction is never prejudicial in registering apparatus if all parts are in motion or are subject to the influence of vibration. Although when at rest the friction between the crown and the fixed core of the pulley is very great, because the entire pull of both tensions of the belt is brought into action, this objectionable influence disappears entirely when the pulley is turned. The mercury column rises and falls to the extent of a millimeter, with the smallest change in the load, in which fact Herr von Hefner-Alteneck sees a proof that friction has no permanent influence on the indications; but another factor enters into consideration which must be allowed for, and that is the centrifugal force of the rotating liquid.

For determining the constants of the apparatus, the following method is employed: The first thing to be determined is the exact pitch of the screw upon the fixed pulley. Thus $R = \frac{a}{b} R'$; where R is that radius of the screw in which the pitch is as 1 to 1, that is 45 degrees; r the radius of the piston; b the length of the arc described by the crown relative to the fixed pulley; and a the displacement side-wise of the crown. Further let:

r = radius of the piston in the meters.

h = difference in level between the two arms of the mercury column.

h' = difference in level in centimetres produced by centrifugal force.

s = specific gravity of the inclosed liquid [for glycerine, $s = 1.26$].

n = number of revolutions per minute.

P = power exerted (pressure on piston) with radius R (where pitch of screw is 45 degrees).

N = number of h. p. transmitted by the pulley.

Then:

$h' = 0.00206\ n^2\ r^2\ s.$

$P = 425.6\ r^2\ (h + h').$

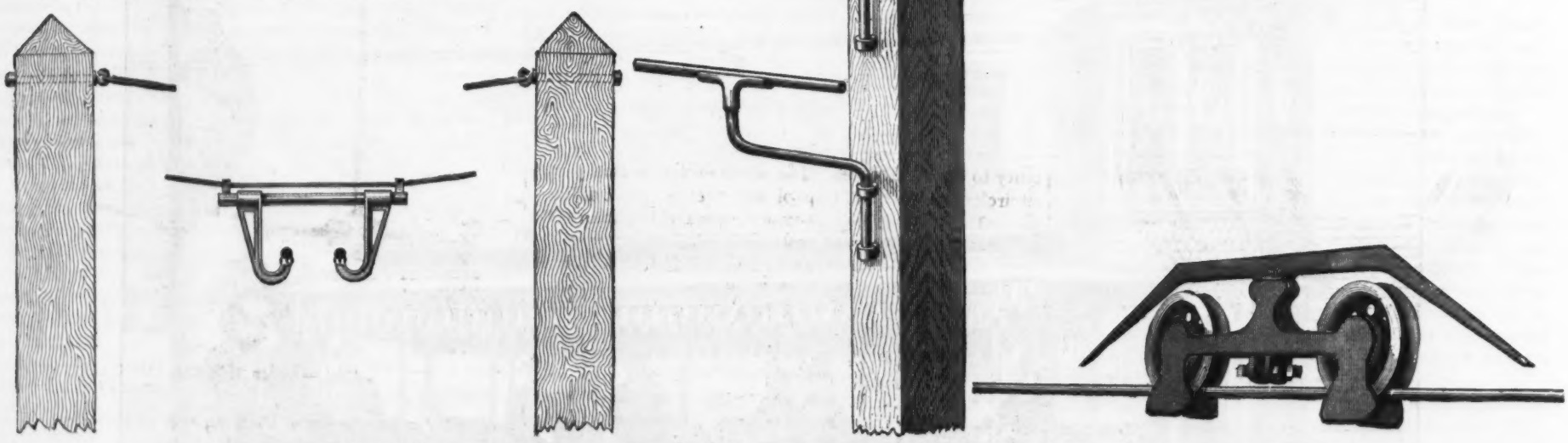
$N = 0.594\ R\ r^2\ n\ (h + 0.00206\ n^2\ r^2\ s);$

Where R and r is given in metres, h and h' in centimetres and the specific gravity of mercury is taken as 13.55.

From these formulas it is evident that it is only necessary to make r sufficiently small, in order to make the quantity $h + h'$ appear correspondingly large for all values of P. The mercury column can be made of any height and diameter, and any degree of sensitiveness obtained in this way. This hydraulic dynamometer is equally well adapted for small powers as well as the largest.

The United States Supreme Court on Telegraphic Delays.

Among the decisions rendered by the Supreme Court of the United States, on Jan. 30, was one involving the question of the responsibility of a telegraph company for neglect and delay in the delivery of a telegram. The case in which this question arises is that of the Western Union Company against George F. Hall, brought up by a writ of error to the Circuit Court for the Southern District of Iowa. On Nov. 9, 1882, George F. Hall telegraphed from Des Moines, Iowa, to Charles T. Hall at Oil City, Pa., an order to buy 10,000 barrels of petroleum, if thought safe. Through alleged negligence on the part of employés of the Western Union Telegraph Company this telegram was not delivered to the addressed until six o'clock in the evening, when, the Exchange having closed, it was too late to execute the order. At the opening of the Exchange on the following day the price of petroleum had advanced 18 cents a barrel. Hall contends that by reason of the failure of the telegraph company to deliver his message promptly he lost $1,800, namely, the sum which he would have made had his order to buy been duly executed, and had the oil so bought been sold at the advance of 18 cents on the following day. The court, in an elaborate opinion by Justice Matthews, holds that the only theory on which the plaintiff could show actual damage or loss is on the supposition that if he had bought on Nov. 9 he might and would have sold on the 10th. It is the difference between the prices on those two days which was in fact allowed as the measure of his loss. It is clear, however, that in point of fact he did not suffer any actual loss. No transaction was in fact made, and, there being neither a purchase nor a sale, there was no actual difference between the sums paid and the sums received in consequence of it which could be set down in a profit and loss account. All that can be said to have been lost was the opportunity of buying on Nov. 9, and of making a profit by selling on the 10th, the sale on that day being purely contingent, without anything in the case to show that it was even probable or intended, much less that it would certainly have taken place. Of course, where the negligence of the telegraph company consists, not in delaying the transmission of the message, but in transmitting a message erroneously, so as to mislead the person to whom it is addressed, and on the faith of which he acts in the purchase or sale of property, the actual loss based upon changes in market value is clearly within the rule for estimating damages. But this has no application to the present case. The only damage, therefore, which he is entitled to recover is the cost of transmitting the delayed message. The judgment is reversed and the cause remanded, with directions to enter a judgment for that sum merely.



FIGS. 3, 4 AND 5.—OVERHEAD CONNECTIONS, BENTLEY-KNIGHT ELECTRIC RAILWAY SYSTEM.

The Bernstein System of Incandescent Electric Lighting.

As our readers are aware, Mr. Bernstein has for some years been advocating the series system of electric lighting by glow lamps of low resistance, and a number of installations, especially in factories and mills, have been fitted up on this plan. As early as 1883 Mr. Bernstein showed his system at the Vienna exhibition, but since then he has made considerable improvements in its various details. In principle, the series system has some advantages over the parallel system. In the former it is possible to employ comparatively thick filaments in the lamps, and the result is greater economy than with high resistance lamps. Why thick filaments should admit of being worked at a higher efficiency than thin filaments, and yet last quite as long, has not yet been satisfactorily explained; but it is nevertheless generally admitted to be a fact. On the other hand, if we work both filaments at the same efficiency, the life of the stout filament will be longer than that of the thin filament. Another advantage claimed for the series system is the possibility of keeping the light emitted by each lamp absolutely constant, notwithstanding variations in the total number of lamps supplied from the circuit. In parallel distribution this condition can only be obtained approximately, since the conductors must have a certain resistance, and the loss of potential must, to a certain extent, vary with variations in the consumption of current. In the series system, on the other hand, as long as we keep the current absolutely constant, the light emitted by each lamp must also be constant, whatever the resistance of the leads may be.

To provide against the extinction of all the lamps in case of the breakage of one, says *Industries*, Mr. Bernstein devised, about two and a half years ago, an electromagnetic arrangement to be added to each lamp, which automatically shifts the current from the lamp to a by-pass in case of the lamp failing. Shortly afterward, however, he abandoned this magnetic by-pass and substituted a very simple and ingenious fusible plug.

This plug is inserted as a shunt to the lamp, and consists of two conducting portions, insulated from each other by fibre strips, and a small quantity of a mixture of oxide

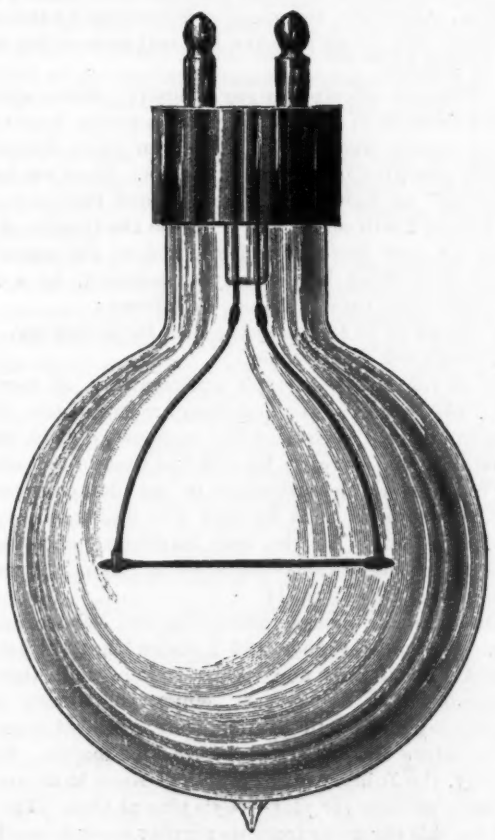
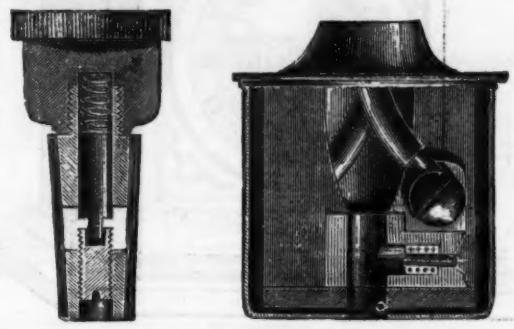


FIG. 1.—BERNSTEIN SERIES INCANDESCENT LAMP.

of mercury and powdered carbon or graphite. This mixture is a very bad conductor when the E. M. F. is only that occurring between the terminals of the lamp; but, upon the lamp failing, the E. M. F. rises to a sufficient degree to electrolyze the paste of oxide of mercury and graphite, forming metallic mercury, and thus establishing the by-pass. To insure greater safety of contact, the centre piece of the plug, which formerly was fixed, has now been provided with a spring, as shown in Fig. 3. When the paste is reduced, and thus shrinks, the spring causes the centre piece to follow into the cup of the lower portion of the plug, making the contact perfect. The plug boxes have also been improved over last year's pattern, and one of them is illustrated in Fig. 2. In the style shown the plug box forms a part of the bracket to which the lamp is attached, as shown in Fig. 3, the ends being screwed to the usual gas thread employed in such fittings. The wires pass through the interior of the tube, and are attached to two metal strips, across which rests a metal spring when the plug is not inserted. In this condition, therefore, the plug box simply short circuits the main leads. When the plug is inserted the insulating part at its upper end raises the spring out of contact with one of the strips, and thus forces the current to pass through the lamp. Should, however, the lamp break, or the plug be inserted when the attendant has forgotten to place a lamp in the fitting, the whole potential difference of the dynamo will, for the moment, come between the lower and upper portion of the plug, electrolyzing the paste, and thus short circuiting the mains. Should the plug be withdrawn before a new lamp is fitted no danger to the circuit or to the attendant can arise, because the top spring simply comes down again and short circuits the connections, so that in this most recent design Mr. Bernstein has provided for all possible contingencies.

Coming now to the lamp Fig. 1, it will be noticed that Mr. Bernstein has abandoned the two-pole type which he originally employed, and now introduces both wires at the same end of the globe. The filament is a straight rod of carbon attached to the ends of two copper



FIGS. 3 AND 4.—LAMP PLUG AND HOLDER.

trips, as shown in our illustration. The leading in wires are of platinum fused into the glass, and connected with two stout brass terminals, shaped as shown. The lamp holder, Fig. 5, has been specially designed to carry the large current of 10 ampères without heating of contacts. The brass terminals of the lamp fit into corresponding holes in gun metal contact pieces supported on fibre, and the terminals are locked in position by means of cross pieces pushed into the nick of each terminal by a spring. One of these terminals is shown in section in the illustration.

Mr. Bernstein proposes to use his system not only for isolated plants but also for central station lighting. The dynamos employed would be designed to give a current of 10 ampères at a maximum E. M. F. of 1,000 to 2,000 volts.

The Sprague Electric Railway at Richmond, Va.

For several months past work on the equipment of the Richmond electric road has been going on. The system is the Sprague Electric Motor and Railway Company's which undertook the work of converting the horse railroad into an electric one, with overhead wires and ground return. Within a week the road has been started in successful operation, about a dozen cars now running, and others to the number of forty are under way.

The total trackage of the Richmond street railway is about twelve and a half miles. It runs a very irregular course, and reaches the principal parts of the city. About nine miles of streets are embraced in it. The central section is double track for a distance of something over two miles, a part being laid on paved streets and the balance on macadam or unpaved streets, while all the extension and branch lines are on unpaved streets, many of them in clay soil, where it would be almost an impossibility to operate horses. The double-track section partly encircles the old State Capitol and presents great difficulties. This part of the line, in a distance of less than 1,000 feet, has on both east and westbound tracks four curves, the inner rails of the westbound track being about 27, 30, 40 and 30-foot radius. The power necessary to turn these sharp curves with a track of standard gauge and with a wheel basis of 6 feet, is much increased by the fact that grades are encountered on the curves as high as 7 per cent., and the lay of the street has required some of the outer rails to be some inches below the inner one. Running eastward from the capitol, the road descends to a low valley through a series of grades varying from 3 to 10 per cent., and then ascends a series of sharp grades and curves in a new district to one of the car-houses. Going west from the State-House the road rises to nearly the highest point in the city, and then runs through a residential district across the R., F. & P. road, and, after several sharp curves, extends a further distance of two miles to a second car-house beyond the new reservoir. Two branches connect with the main line, one leaving it at the old Market Place, crossing and paralleling the C. & O. Ry. and terminating at its machine-shops. The other runs into what is popularly known as "Africa," a section almost exclusively inhabited by a colored population. The narrow streets, their heavy character, and the lack of paving, especially in the new districts, makes the road one of exceptional difficulty to operate. There are no less than thirty-one curves requiring bent rails, the majority being of sharp radius, five being less than thirty-one feet.

The power house is situated two blocks away from the nearest point of the line, and is almost equi-distant from its extremities. As a distributing point it is, therefore, both theoretically and practically, a "central station." The property includes three brick buildings, the main building, in which are located the engines and dynamos, being separated from the other two by a covered driveway. Wagons entering this drive-way pass on to a pair of scales, leaving the engine-room to the left, the office building to the right, and further on the boiler room, also to the right. As the station is only 300 feet distant from the depots of three railroads, coal can be obtained almost at the door.

Starting at the source of power, the boiler-room is a one-story building, 38 × 71 feet and 20 feet high, and an engine room 77 × 64 feet. The battery consists of three cylindrical return-tubular boilers of the latest pattern, equipped with the Jarvis patent furnace, their capacity being 125 horse-power each. Water is supplied to them by two Worthington steam pumps, which take their supply either from the city main or from a well which has been dug in the yard, and which supplies a very clean, soft water.

The engines, of which there are at present three, are of the Armington and Sims type of high-speed engines, and develop, when running at full load, 125 horse-power each. The engine drives two Edison dynamos of 40,000 watts capacity each, specially wound for 500 volts normal pressure. The dynamos feed into copper "bus" bars, supported on walls by porcelain insulators. Each machine has its independent ampère meter, and in addition there is a general ampère meter at the end of the positive "bus" bar. From this bar the current passes to four special snap switches, each switch being connected, through a handsome three-plug safety switch block, to one of the feeders supplying current to the main line wire. These four feeder wires tap into the line wire at four different points, thus maintaining the pressure approximately equal all along the line. At the ends of the feeders in the central station, pressure indicators are attached, which indicate the voltage at the junctions of the feeders with the main current wire.

The motors, of which there are two on each car, have a nominal capacity of 7½ h. p. each, and can for a short time work up to 15 h. p.; two are capable of producing a momentary tractive effort of over 3,000 pounds. The cars can be run at widely different speeds, varying from the slowest crawl to 12 or more miles per hour. They can be started and stopped without the use of brakes in the space of three or four inches, and when making the normal running speed can in an emergency be stopped and reversed without brakes within less than a quarter of a car-length. To show the power of the machines, the cars have been stopped and started on an 8 per cent. grade in the middle of a 27 foot curve, and one motor has propelled two cars around sharp curves and up decided grades.

The active management is in the hands of Mr. George A. Burt, the former General Manager of the Panama Railway. In extent and completeness this electrical plant is

FIGS. 5 AND 2.—LAMP HOLDER AND PLUG.

said to exceed anything of the kind ever undertaken. The full equipment is to consist of 40 cars with 80 motors, more than exists on all the European roads combined. The cost of the steam and electrical equipment alone is considerably over $100,000.

Motors and Commutators.

To the Editor of The Electrical World:

SIR: Will you please inform me through the columns of your journal, (1) if I can run 2 motors on a circuit of 150 volts. The motors are of 3 h. p. each. Can you inform me also, (2) if a copper commutator is better than a brass one.

C. J. G.

WORCESTER, Mass.

ANSWER.—If your motors are properly wound, and are furnished with sufficient current, you can run them on a circuit of 150 volts potential. (2) If the machine runs without sparking, there is practically very little difference or choice in the matter of commutators as to material. When running without sparking, a brass commutator may last a little longer than a copper one, as the principal wear comes upon the softer copper brushes. But if sparking is liable to occur, copper will stand better than brass, as it is not so easily burnt.—EDS. E. W.

Some Additional Data on the Incandescent Lamp Freak.

BY E. R. KNOWLES.

I wish to add a little data to that already given as to the cause of the "Incandescent Lamp 'Freak,'" first mentioned in the issue of the 28th of January, 1888.

Some years ago, while engaged in the manufacture of lamps for William E. Sawyer, and also later, while manufacturing lamps for the Consolidated Electric Light Company, I observed the occurrence of numerous examples of this form of "freak" during the manufacture of the lamps, and I had occasion to investigate the cause of this phenomenon. I have had the pleasure of watching the whole performance from beginning to end a large number of times, and, in my experience, the cause was as follows:

At first either the loop was nearer the globe on one side or the other, the globe being of uniform thickness, or, the loop being central, the glass was thinner at one spot than another; or both together, *i. e.*, the loop was not central and the globe was thinner where the loop was nearest to it. In any event, the action began by the part of the globe to which the loop was nearest, or the part of the globe which was thinnest (and this was the most common occurence) was heated more than the surrounding portions of the globe. A slight depression was slowly formed, the glass being pushed in by the pressure of the outside air, thus stretching and making the glass thinner at this spot, and bringing the glass nearer to the source of heat. The action then increased, became gradually more and more rapid, the glass went further and further in, forming a sharp cone, until it was so thin that the pressure of the air forced an opening, and the loop was immediately broken and the lamp extinguished. This was my experience in every case which came under my notice, and, in my opinion, the reason for this "freak" is almost invariably due to the before mentioned causes.

Irish's Electric Regulator and Meter.

In a new apparatus designed by Mr. W. E. Irish, of Cleveland, O., the inventor has sought to provide means whereby a registry shall be made of the electric energy expended, or of the number of electric lamps or motors that are in use in a local circuit during any given period of time, as well as the length of the time during which the lamps, etc., are used. That is, the apparatus is designed to register the expenditure of current during a given time and the point of time when a lamp or motor is switched into its local circuit, and also the time when a second or third or fourth lamp or motor is switched in, and the time when any one or all of them are switched out of the circuit. The apparatus is located at the point where a branch local or consumers' circuit is taken off the main circuit. It thus furnishes a scale on which to regulate the supply and make charges to the consumer, and is designed as a protection both to the consumer and the supplier.

Fig. 1 shows a diagrammatic view of the apparatus with a local circuit containing electric lamps in multiple arc and a registering apparatus capable of registering the use only of four lamps or motors. It is obvious, however, that the capacity of the registering apparatus may be increased to any desired limit. It is not necessary that the lamps should be in multiple arc, although the illustration shows the apparatus especially adapted to that system.

Referring to Fig. 1 it will be seen that the main circuit enters and leaves the apparatus at the binding posts on each side of an ebonite cylinder holding mercury. One post is connected with a plate *P* within the cylinder, while the other post is connected with a series of carbon resistance rods *C*, also terminating within the cylinder, but on the opposite side; the circuit being through that portion of the plate touching the mercury, and such of the carbon rods as are covered by the mercury. The current to customers is supplied through the shunt or derived circuit.

The current, on passing through the solenoid *S*, actuates the core and makes a record of the number of lamps or motors in circuit. When none of the lamps are in use the solenoid is not energized, and the piston which plays within the cylinder and acts upon the body of mercury also contained therein, being free to respond to the action of gravity, falls so far into the cylinder as to cause the mercury to ascend and cover the plate and all the resistance rods. The mercury is raised or lowered from a certain normal height according as the piston is caused to fall or rise.

The piston is connected with the movable core of the solenoid. Above the latter on the piston rod is secured a pencil or marker *M*, whose point stands in the line of motion of the drum *D*. The latter is constantly rotated by means of its clockwork. In this position of the parts the main circuit receives the full current on the line, and the position of the marker is in line with the space marked zero on the calendar and will make a mark around the drum through that space so long as that position is maintained. Suppose, however, that one of the lamps or motors is switched into circuit; a part of the current will traverse the solenoid and the core and piston will be lifted. This will cause the mercury to descend somewhat along the plate and the resistance rods and thereby interpose resistance into the main circuit in direct proportion to the amount of current needed to supply the lamps or motors. Meanwhile the marker has been raised with the core and been brought into line with the space 1, so that a mark will be made through that space so long as a single lamp or motor is in use. The point also at which the mark passes from space to space indicates the time when the lamp was switched into circuit.

The same thing will happen when a second, third or fourth lamp is switched in; and when any one or all of

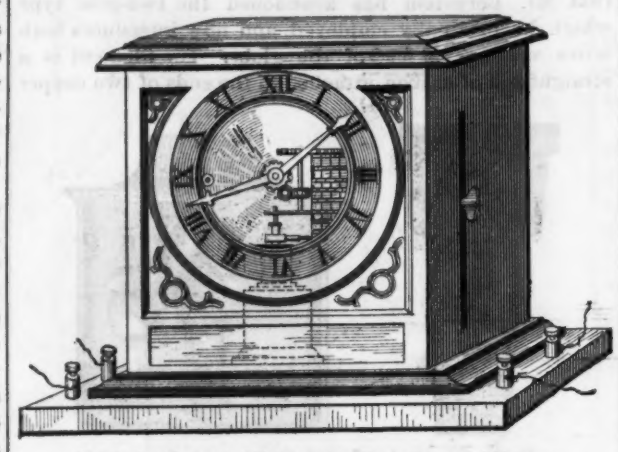
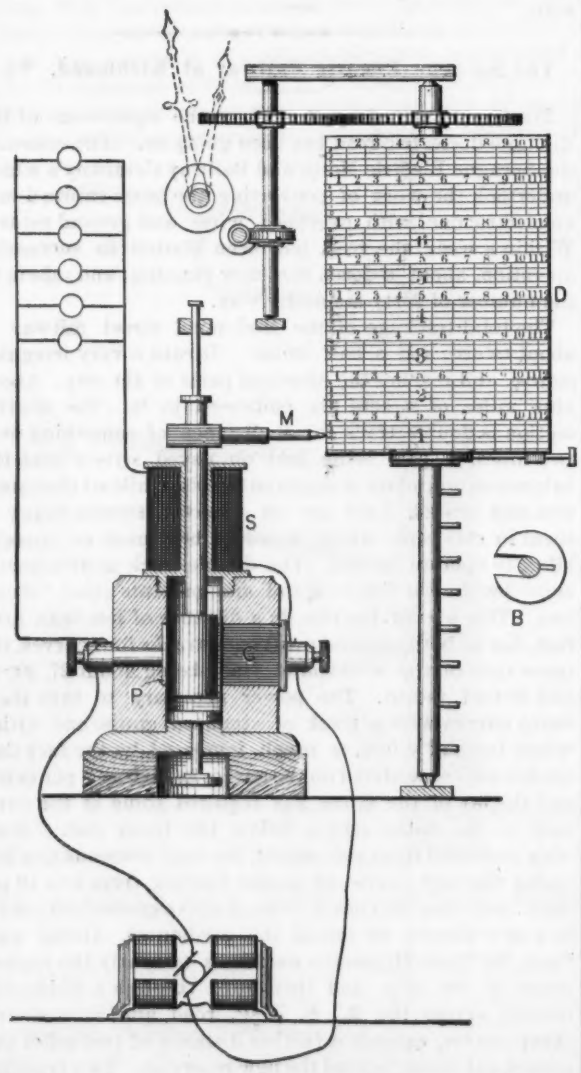


FIG. 3.—IRISH'S ELECTRIC RECORDING METER.

them are switched out of circuit the reverse operation will take place, and the time when the switching out happened will be marked on the drum as before.

The apparatus thus furnishes a gauge for making charges to customers or recording the expenditure of electrical energy at the generating station or elsewhere on the main or derived circuit.

As the drum revolves a mark is made on the paper calendar by the pencil. The paper which is contained within the drum is in one continuous roll containing 31 calendars perforated ready to be torn from the roll. It will be observed that the paper is divided into eight series of spaces, which run around the drum, the spaces of each series being numbered 0, 1, 2, 3, 4, from bottom to top. It will



FIGS. 1 AND 2.—IRISH'S ELECTRIC RECORDING METER.

also be noticed that the drum is divided lengthwise into 24 spaces, numbered in the natural order of numbers. The numerals extend around the circumference in spaces located just above the series already described. Thus each succeding two of the eight series of spaces are separated by a space, within which the numbers 1, 2, 3, 4, etc., up to 24, follow each other in natural sequence. The clockwork is so timed as to cause the drum to make one complete revolution every 24 hours. Now, as each of the spaces numbered 1, 2, 3, 4, etc., forms $\frac{1}{24}$ part of the circumference of the drum, it is obvious that the latter will be moved the distance of one space during every hour, and thus whenever the clockwork is released the pencil will come in contact every hour with a portion of the drum equal in extent to the length of one of these spaces.

The drum is loosely mounted on a shaft which is provided with a number of pins arranged up and down upon the shaft almost, but not quite, in a vertical line. Beneath the drum is placed a metallic piece *B*, Fig. 2, which is cut away on one side from the centre to the circumference, leaving a space slightly wider than the shaft. A rod is attached to this piece on the opposite side from the opening and forms a means by which the said piece can be slipped over or around the shaft from the outside of the drum. The piece is also provided with a slot somewhat larger than the size of each of the pins. The drum is first raised into position on the shaft, and the projecting piece, shown on the right at the botton of the drum, is pushed into place and the whole then rests upon one of the pins. The positions of the slot and the pins are such that when the drum is in its starting position, shown in Fig. 1, the pin is only slightly out of line with the slot, but the direction of rotation of the drum carries the slot further away from the pin, until, at the expiration of twenty-four hours, the slot and pin come into alignment and the former passes over the latter, allowing the drum and its connected parts to drop to the next lower pin.

The numerals on the drum arranged in a vertical column from 1 to 8 represent days of the month; they extend as a rule from 1 to 31 so that the calendar needs removal once a month; but for the sake of clearness the drum is shown during only eight days. The distance between any two succeeding pins on the shaft is equal to the distance between any two corresponding spaces numbered 0, 1, 2, 3, 4. For this reason when the pencil or marker stands in line with a given space, in, say, the first or lower series of spaces, the dropping of the drum will cause it to stand opposite a corresponding space in the second series, and so on.

Fig. 3 shows the complete apparatus. The clock dial is of glass and through it the records on the drum can be read as made, and hence easily verified.

The Storage Car Competition Declined.

To the Editor of The Electrical World:

SIR: I find Mr. Wharton's renewed challenge in your last issue. As before, the question is studiously handled by the wrong end, so as to leave the real issue as far out of sight as possible.

Mr. Wharton attempts to say "smart" things *apropos* of the difference in gauges; but his remarks would have sounded better, and would have been more interesting had they appeared in his first challenge. They are hardly "previous" enough, as it were, to have full force upon me. I trust I will spare Mr. Wharton the trouble of any further *ex post facto* witticisms, and at the same time succeed in making him clearly understand, by a statement made, this time in italics, as follows:

1. *I cannot go to Philadelphia with the Julien car.*
2. *I would not go if I could.*

Now, as for Mr. Wharton's anticipations of new excuses, I need scarcely say that they are gratuitous. When he has sufficiently recovered his composure to be able to understand what he reads, he will find that I have already made my reasons clear enough in my last communication. While he is at it he will also find some healthy food for reflection in the very intelligent observations and pertinent suggestions made by Mr. Geo. B. Prescott, Jr., in your issue of Jan. 14.

I said distinctly enough before, that Mr. Wharton ought to have challenged sooner, and I stated that the car was engaged. I will only add as an item of fact, that the arrangements for the "match," which the Julien car is now running on Fourth avenue, were made at least two months before Mr. Wharton proposed *his* match. To put it plainly, the Julien car has practical work to do and has absolutely no time for play--boy's play at that. The idea of taking this car away from its regular work to send it to a "laboratory" for the purpose of trying a few experiments of no significance or value, must indeed seem highly ridiculous to all except Mr. Wharton. Mr. Prescott, for one, must be greatly amused. This is reason enough of itself why I would not go; though I must frankly state that a greater objection would be Mr. Wharton himself. The fact is simply, that while the "Alpine" avalanche of ridicule which he so majestically launches at me has not crushed me in the least, as he may have expected; it has, however, made me lose some respect for him, since it lays bare another peculiar and to me repugnant feature of his philosophy—the substitution of ridicule for argument. Under the circumstances, I will also ask Mr. Wharton to continue the discussion alone from this point, Mr. Editor, for I have too deep a regard for the standing of your estimable journal as a scientific publication to fight on *that* line. I have pointed out to Mr. Wharton the only satisfactory method of determining the merits of any system of electric traction. I have also informed him that he can in a short time see the Julien system weighed in the balance, on a good-sized and a practical scale. In a word, I have shown him how to get at the truth, and the whole, entire truth. I shall make no further attempts to satisfy him. The fact is, I do not feel like wasting time or energy in a Don Quixotic charge against windmills.

C. O. MAILLOUX.

Jan. 30, 1888.

Dynamo-Electric Machines in Telegraphy—The New Plant in the Western Union Building, New York.

BY WM. MAVER, JR.

It is pretty generally known that, prior to the introduction of dynamo-electric machines in the Western Union building, in September of 1880, as a source of electromotive force in the operation of the wires emanating from that building, gravity or Callaud batteries were used for both the main or through and the local circuits.

The introduction of these machines dispensed with all the gravity cells required for the operation of the main circuits, at that time amounting to about 10,000 cells. The local circuits—that is, those circuits that do not go outside of the building, and short loops to branch offices in the city—were left undisturbed, and gravity battery is still employed in their operation.

At the present time it is estimated that at least 35,000 cells of gravity battery would be required in the working of the main circuits now entering or leaving the Western Union office.

These figures show that in less than ten years the amount of electromotive force necessary for the operation of the main circuits out of this office has increased about three and one half times; further evidence, if any were needed, of the rapid growth of the Western Union system. It may be mentioned, however, that considerable of this increase is doubtless due to the establishment of many additional quadruplex circuits in that time. A successful quadruplex system, it is well known, gives the equivalent of four wires for one, but requires for its proper operation, roughly speaking, about twice as much current as would be used in the operation of four single wires. This increased battery is of course a mere trifle compared with what would be the first cost and subsequent maintenance expenses of three "actual" wires.

The cost of maintaining one gravity cell is about $1 per annum. The cost of maintaining a suitable dynamo plant is probably about $5,000 per annum. Thus the economy of the change from gravity battery to dynamo-electric machines is very obvious, especially when it is considered that the first cost of a suitable dynamo plant and equipment will not much exceed that of 10,000 gravity cells. Had not the gravity cells been supplanted by dynamo machines in the Western Union Building, however, it is very likely that another question, other than the cost of maintenance, would have arisen, namely, the question of room for the rapidly increasing amount of gravity battery, and this would probably have necessitated the employment of some form of chemical battery with a higher electro-motive force than the Callaud as a temporary relief. In a building situated in so important a portion of the city as the one in question it is perhaps safe to conjecture that the rent of the room space formerly occupied by the gravity cells would more than offset the total cost of the dynamo machine plant.

The original dynamo plant was located in a portion of the sixth floor of the Western Union building. It consisted of fifteen machines of the Siemens type. These machines furnished an electromotive force of about 80 volts, and had an internal resistance of .6 ohm each. The fifteen machines were divided into three series or gangs of five machines each. One machine in each gang was used exclusively as an exciter of the fields of the other four machines. These other four machines were connected in series, as shown in Fig. 1, and furnished a total electromotive force of 320 volts. Two of the three "gangs" of machines were always in operation. The other was a spare or emergency series. One of the active gangs furnished negative polarity to the wires, the other supplied positive polarity. The spare series was provided with a commutator, not shown in Fig. 1, between the exciter *A* and the next machine *B*, by means of which it could be made to furnish either polarity, as desired.

Four grades of potential were furnished by each series. In Fig. 1 the machines *B*, *C*, *D*, *E*, are shown as furnishing 70 volts each, which was the original potential, but it was found requisite to speed the machines up to 80 volts each. The diagram illustrates the manner in which the current from the different machines was led to the wires. The circuit took "ground" from the lower brush of machine *B*. This machine furnished what was known as the first potential, 80 volts. The second machine, *C*, added its 80 volts to that of the first machine, raising the potential to 160 volts, which was known as the second potential; machine *D* contributed another 80 volts, raising the electromotive force to 240 volts, known as the third potential; and machine *E* also added 80 volts, giving a total electromotive force of 320 volts, known as the fourth potential. Each potential was led to a thick strip of brass, *R*, behind or under the main switch-board, in the operating room, as shown in the diagram. Resting on this strip of brass were numerous coils of German silver wire wound around plaster of paris cylinders. These coils had a resistance of about 600 ohms each and one of them was interposed between the machines and each wire leaving the office, the object of which was to diminish the intensity of the current, thereby measurably preventing sparking at the contact points of the telegraph instruments.

The wires having an average resistance of about 3,000 ohms were supplied from the first potential. Those of about 5,000 ohms from the second potential. The third potential was used chiefly for duplex and quadruplex circuits, and the fourth potential for very long quadruplex circuits.

Such circuits as those to Jersey City, Long Island, Brooklyn and uptown in New York being of low resistance, were also supplied from the first potential, but the resistances of such wires were increased by the insertion of artificial resistances to an average resistance of 3,000 ohms.

Fig. 1 is here reproduced from an article by the present writer, descriptive of this plant, which appeared in this journal in 1883. As the caption of this article indicates, the original plant has been superseded by an improved set of machines and a new arrangement of them, embodying several marked changes, the explanation of which will, I think, be facilitated by reference to and comparison with the original arrangement.

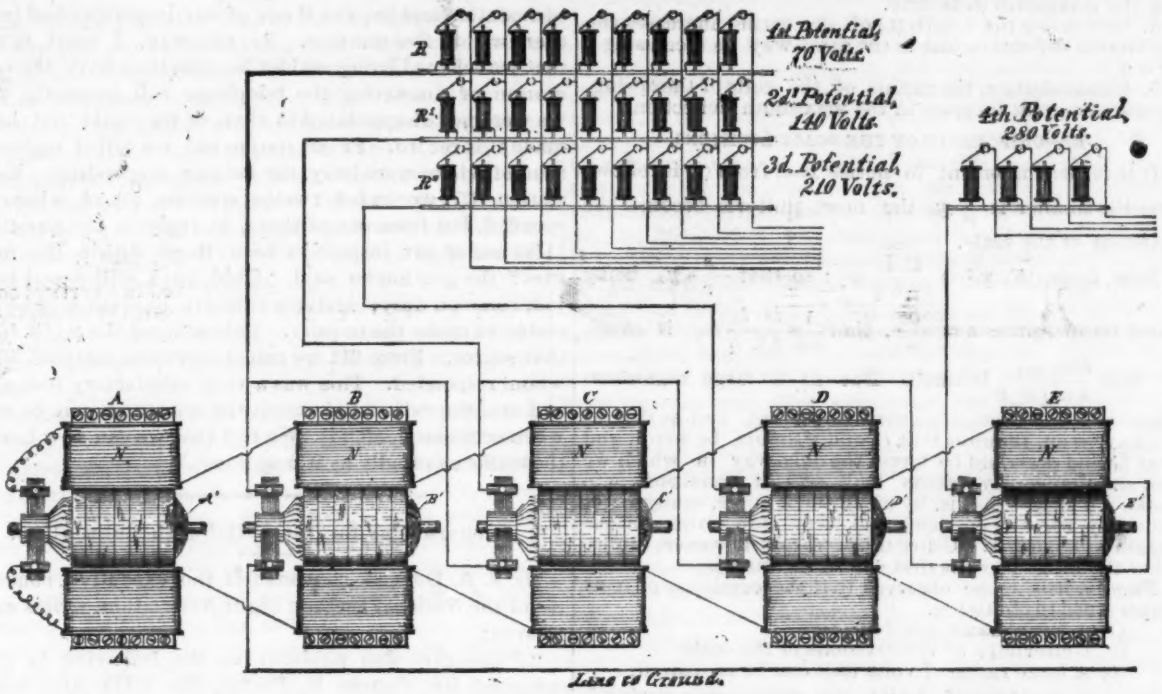


FIG. 1.—WESTERN UNION DYNAMO TELEGRAPH PLANT—OLD METHOD.

The original arrangement of the machines, the invention of Mr. Stephen D. Field, was found in the main very satisfactory, and especially so when it is considered that it was the first instance of the use of dynamo electric machines for the generation of telegraph currents on a large scale. It had, however, one or two defects, one of which was that in very bad weather when the resistance of the external circuits fell to a low point and it was desired to increase the output of the machines most drawn upon by increasing the field magnetism, this could not be done without at the same time increasing the fields of all of the machines, as their field circuits were in series; and any attempt to increase the capacity by speeding up the machines incurred the danger of throwing off the belt.

Another defect was that the range of available potentials, namely, four, as above mentioned, was somewhat limited for the requirements of the service.

When, therefore, the rapidly growing demand for increased electromotive force threatened to exceed the capacity of the original machines and called for others of greater capacity, it was decided to design a new arrangement of the machines, to remedy the above noted defects, and this has been done very successfully and ingeniously by Mr. George A. Hamilton, electrician, and Mr. A. S. Brown, of the Western Union Company.

Fig. 2 is a theoretical diagram, showing one series of the machines in the new arrangement.

A marked difference between this arrangement and that shown in Fig. 1 will be observed. Five machines are still retained in each series, but all of them are in series with each other. The machine *E*, it will be seen, is shunt wound and self-exciting. It also excites the fields of the other four machines. These five field circuits are arranged in multiplex arc and each circuit is equipped with a resistance box *R* by means of which the strength of current in any one of such circuits can be increased or decreased at will, and in this way the capacity of any one of the machines may be varied as required. Normally the external resistance of the field circuits of each machine is equal, namely, about 17 ohms.

Besides acting as an exciter of the field magnets of itself and the other four machines, the fifth machine *E* furnishes a fifth potential of 60 volts to the wires, and in this way an additional "grade" of potential is secured with the same number of machines as in the original arrangement.

In Fig. 2 the arrows show the assumed direction of the current, that is, positive. It may puzzle some, overlooking the cause, to observe that the course of the current in the field magnet circuits is, as it were, against the current from the machines *A*, *B*, *C* and *D*. Were the machine *E* not in the circuit the direction of the current from the machines *A*, *B*, *C* and *D* would, of course, be in an opposite direction to that shown by the arrows in the field circuits. But it is just the presence of the machine *E* that makes the difference, inasmuch as it raises the potential another 60 volts, and as a current is assumed to flow from a higher to a lower potential it naturally flows from a point where the potential is, say 320 volts to a point where the potential is only 240 volts.

The new plant has been located in the sub-cellar of the building owing to the pressing demand for additional space for cloak room, etc., on the sixth floor. Like the original plant it consists of 15 machines, and it also resembles that plant in many other features. It is divided into 3 series of 5 machines each. Two series are always in operation; the third is a spare series. As in the old arrangement also, one of the series is permanently arranged to furnish positive, the other negative, polarity. The spare series, by means of a commutator and ingenious connections, furnishes either positive or negative polarity, as required.

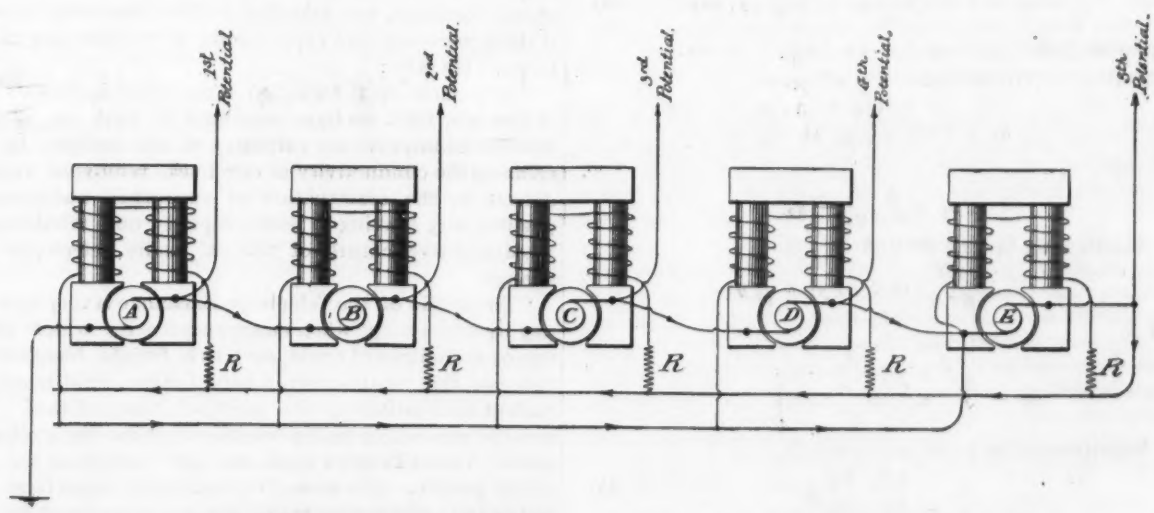


FIG. 2.—WESTERN UNION DYNAMO TELEGRAPH PLANT—NEW METHOD.

(To be continued.)

A Cushman Plant Sold Out.—The St. Clair & Sinalao Telephone Company, of Detroit, which has operated 150 miles of "opposition" telephone lines, has sold out to the Bell Company at about $100 per mile, rather than stand suit. The Cushman telephone used by the St. Clair Company will be replaced by the Bell instrument.

Portable Voltmeters for Measuring Alternating Potential Differences.*

BY W. E. AYRTON AND JOHN PERRY.

(*Continued from page* 56.)

C.—THE RANGE IN VOLTS.

If θ_1 be the highest temperature of the wire allowable; if v_1 volts be the range of the instrument without using external resistance coils, then, from (4),

$$v_1 = 2\, l_o \sqrt{\frac{\varepsilon\, \rho\, \theta_1}{d}}; \qquad (10)$$

so that this range is proportional to l_o—that is, to the length of wire through which the current passes in going from one terminal to another of the instrument. Hence, if there are 10 wires, each of length λ_o, we can make $l_o = 10\, \lambda_o$ by placing the wires in series, or $l_o = \lambda_o$ by placing them parallel by means of a commutator.

Since, for small wires, ε is inversely as d, the range in volts increases directly as the length of the stretched wire and inversely as its diameter. As, however, increasing the length increases the waste of power in the instrument, it is rather by diminishing the diameter of the wire that the range in volts ought to be increased.

If a small range in volts be desired, it is better, in order to avoid waste of power to use one thick wire than several thin wires in parallel; and this rule ought to be followed as long as the thick wire is sufficiently quick in its action.

In order, however, to obtain a great range, it may in many cases be desirable to employ a many-wire voltmeter with a commutator, in spite of the fact that this arrangement does not give us the instrument that is most economical in the power wasted when a few volts are being measured.

D.—THE GREATEST ANGULAR DEFLECTION OF THE POINTER.

With any given spring, it is obvious that we ought to tighten the wire and adjust the initial tension in the spring until the initial pull in the wire is q—the greatest pull to which the wire ought to be subjected—and also until we find that at the highest temperature the spring is just able to keep the wire taut. In our instruments where the wires lie nearly all parallel to one another we have these two adjustments, and also in those with the bicycle wheel arrangement of wires, in which the outer ends of the wires may be attached to adjustable flexible strips. For the sake of easy calculation we may take the final pull in the spring as 0. Let L be the length of the spring; φ_1 the deflection of the pointer when θ_1 (the highest temperature of the wire) is reached, P_o the initial pull in the spring. By the triangle of forces

$$P_o = \frac{4\, y_o\, q}{l_o} \qquad (11)$$

(If there are n wires caught by the end of the spring, say n complete diametral wires is the bicycle-wheel form, then instead of q we must use $n\, q$.)

The law of the spring is such that

$$y_1 - y_o = r\, P_o\, L\, \frac{a}{t^3}; \qquad (12)^*$$

where r is the radius of the coils of the spring, L its axial length, a a constant depending on the material of the spring, t the thickness of the strip of which the spring is made; and another law of the spring is

$$\varphi_1 = P_o\, L\, \frac{b}{t^3} \qquad (13)$$

where b is a constant like a. In fact, $\frac{b}{a}$ is the constant s used in (6).

Substituting for P_o from (11) in (12),

$$y_1 - y_o = r\, L\, \frac{a}{t^3} \cdot \frac{4\, q}{l_o} y_o = s\, \frac{r}{t^3} y_o, \text{ say;} \qquad (14)$$

equation (2) is $y_1^2 - y_o^2 = \frac{1}{4} l_o^2\, a\, \theta_1 = R$, say.

Dividing by (14), we have

$$y_1 + y_o = \frac{R\, t^3}{s\, r\, y_o};$$

so that

$$y_1 = \frac{R}{s}\frac{t^3}{r\, y_o} - y_o.$$

Substituting in (14), we find

$$\frac{R\, t^3}{s\, r\, y_o} - 2\, y_o = s\, \frac{r}{t^3} y_o,$$

or

$$y_o = \sqrt{\frac{R}{s\, \frac{r}{t^3}\left(s\, \frac{r}{t^3} + 2\right)}}$$

Substituting for P_o from (11) in (13),

$$\varphi_1 = \frac{L\, b}{t^3}\, \frac{4\, q}{l_o}\, y_o \qquad (15)$$

and using y_o, just found, in which $R = 2\, l_o^2\, a\, \theta_1$, and $s = \frac{4\, L\, a\, q}{l_o}$, we find eventually that

$$\varphi_1 = \sqrt{a\, \theta_1\, \frac{b^2}{a}\, 2\, \frac{L\, q\, l_o^2}{L\, a\, q\, r^3 + r\, t^3\, l_o}} \qquad (16)$$

where neither of the two terms in the denominator is negligible. The observation in brackets given after (11) tells us that we may use $n\, q$ instead of q in the formula if there are n lengths of wire or n complete diametral wires in the bicycle wheel form of instrument. An examination of (16) will show how the range φ_1 may be made large.

The following are the deductions that may be drawn from (16):—

1. If f be the working stress suitable for the material of the wire,

$$q = f\, \frac{\pi}{4} d^2,$$

or

$$n\, q = n\, f\, \frac{\pi}{4}\, d^2;$$

so that, if we desire a large maximum deflection without reference to the range of volts, we ought to use wires as thick as possible, or else use many spokes in the bicycle wheel form. The limit to the thickness that may be given to the wires arises from the fact that the heat equilibrium will only be established slowly with thick wires, so that the dead-beat character of the instrument suffers if the wires be too thick.

2. The greater l_o is, the greater is the maximum deflection. Hence the greater the diameter of the bicycle wheel and the more numerous the spokes, the greater the maximum deflection. Also, the greater the diameter of the bicycle and the greater the number of spokes, still more noticeable is the range in volts.

3. Diminishing the thickness (t) of the strip of metal of which the spring is made has a *very great* effect in increasing the maximum deflection.

4. Increasing the length (L) of the spring increases the maximum deflection just in the same way as increasing q or $n\, q$.

5. Diminishing r, the radius of the coils of the spring, produces a great increase in the maximum deflection.

E.—UNIFORMITY OF THE SCALE DIVISIONS.

It is rather important to notice that from (9) it follows that the smaller is $\frac{s}{r}\, y_o$ the more uniform become the divisions of the scale.

Now, from (15), $y_o = \frac{t^3\, l_o}{4\, L\, b\, q}\, \varphi_1$; so that $\frac{s}{r}\, y_o$ being small means, since $s = \frac{b}{a}$, that $\frac{1}{a\, r}\, \frac{t^3\, l_o}{4\, L\, q}\, \varphi_1$ is small, or that $\frac{t^3\, l_o\, \varphi_1}{4\, L\, q\, a\, r}$ is small. But as a large maximum value of the deflection is very important, and as this, as we have seen, requires that t and r should be small, and that l_o and q should be large, the only way in which we can simultaneously satisfy both sets of conditions is to make $n\, q$ large—that is, by using thick wires, many wires (as many wires as possible), and very thin strips for our magnifying spring. Using thick wires, however, diminishes the range of volts that can be measured.

Finally, it is to be observed that the condition of most importance in obtaining,

(1) A large maximum deflection,
(2) Uniformity of the divisions of the scale,
(3) A large range of volts that can be measured,

is to make the strip of which the magnifying spring is made *as thin as possible.*

(*To be continued.*)

* "A New Form of Spring for Electric and other Measuring Instruments."—*Proc. Roy. Soc.*, No. 230, 1884, p. 311.

Telephone Tests in St. Louis.

Recently we made note of some time tests on the Law system in St. Louis. We are in receipt of fuller details, as given below. It will be noted that one operator made the extraordinary record of 53 connections in five minutes:

The St. Louis Telephone Exchange made some interesting experiments recently to determine the variations in five-minute periods of ten hours' traffic from 89 stations served by one operator. The diagram of fluctuations, drawn to show how business with the telephones ran from 8 A. M. to 6 P. M. was quite irregular, and had one tall pinnacle located at 11:40 A. M., this abnormally high point indicating the result of an attempt to force upon the operator the greatest possible number of connections in five minutes. The point was up to 53 connections. The average number of connections, per result of the experiment, were per minute, 1.94; per five minutes, 9.72; per hour, 116.7. General manager Geo. F. Durant, of the Bell Telephone Company, was asked by a *Globe-Democrat* reporter if there were any late experiments in telephoning in St. Louis. He said:

"Ever since the destruction of our central office by fire, in October, 1885, we have been hard at work on various schemes to improve the efficiency of our service, by increasing the conductivity of our lines, removing various defects in the construction of apparatus, and in every possible way striving to secure rapidity and reliability as the distinctive features of the St. Louis Telephone Exchange.

"The traffic of the Telephone Exchange is very uniform day by day, except when emergencies arise which affect one or more lines of trade, such as a freight blockade on the east side of the river, a bank failure, tight money or violent fluctuations in the price of commodities. The greatest amount of traffic was thrown upon the exchange during Veiled Prophet week, and particularly on the day of the parade. The most frequent rushes come from the livery and undertaking trade, and are occasioned by the demands for carriages for funerals."

"How many connections can be made per hour?"

"As many as fifty-two connections in one hour have been made for one liveryman. The banks crowd a great many connections into a small space of time in the mornings, which I think is due to their notifying customers of drafts against them and inquiring about their acceptance.

"The average daily work of the exchange from 7 A. M. to 7 P. M., under ordinary circumstances, from Mondays to Fridays inclusive, is 13,500 connections per day, bringing into use 81,000 stations. On Saturdays the average is 16,000 connections, Sundays 1,900, and holidays 4,600 connections. From 7 P. M. to 7 A. M. the average is 550 connections. The busiest hour in the day is from 9 A. M. to 10 A. M., when we handle about 1,900 connections.

"Here is a chart," continued Mr. Durant, "showing the fluctuations in five-minute periods of ten hours' traffic from a group of eighty-nine subscribers. That very high point in the profile indicates the result of an experiment we tried to-day to test the capability of the system to respond to extraordinary demands that may be made upon it. The operator made fifty-three connections from 11:40 to 11:45 A. M.

"The experiment also demonstrated what an enormous amount of business can be done from a single station of the exchange in five minutes. To force the greatest possible number of connections upon the operator in five minutes, we selected three stations, numbers 643, 627 and 611, in each of which we stationed an operator with a list of twenty livery stables, taken in regular order from the classified list in our directory, with instructions to call each station and inquire if one of our inspectors had been there within five minutes. By the way, I want to say that we selected livery stables because they have the reputation of answering the telephone bell promptly, and we were not disappointed in that, or we could not have made this record. From station 643 we called eighteen, four of whom were busy, the balance responding. From station 627 we called twelve stations, all of whom responded, but from one of these, in reply to the question, 'Has one of our inspectors been there within five minutes?' the gentleman said, 'Hold on, I will see; I have just come on duty;' and accordingly he went around the stable to make the inquiry. This delayed the work from that source. From 611 we called seventeen stations, all of whom responded. This was a very satisfactory test, and, as I say, shows to what extent the telephone can be used when occasion demands. We feel that we can now handle the traffic as rapidly as it may come."

Preparations for the Pittsburgh Convention.

Mr. S. A. Duncan, chairman of the executive committee of the National Electric Light Association, writes us as follows:

"Please give due publicity to the following in your columns: Mr. George F. Porter, No. 1,112 Arch street, Philadelphia, has arranged with all trunk lines east of Pittsburgh for a general rate of one and one-third fare for round trip from starting point for all persons attending the National Electrical Light Association in Pittsburgh. Delegates will pay full fare to Pittsburgh and a certificate will be issued to them by the secretary for a return ticket with the rebate. All who desire attending the convention will please send their names at once to Mr. Porter, who will have the necessary certificates made out, and also state whether they desire sleeping car accommodations from New York on the special train Sunday evening, Feb. 19."

Mr. George T. Bowen, of Elgin, Ill., has issued the following, as chairman of the Committee on Transportation:

DEAR SIR: I have arranged with the Central Traffic Association for reduced rates (as per inclosed circular) for all delegates attending the meeting of the National Electric Light Association, to be held in Pittsburgh, Feb. 21, 22 and 23 next.

Take a certificate from the agent you purchase your ticket of and it will entitle you to a return ticket at one-third regular fare.

The meeting is important and a large attendance is expected. A special car will be provided for delegates, leaving Chicago, Monday, 3:15 P. M., Feb. 20, Union Depot, Madison and Canal streets.

Kindly advise me of your intention in order that provision for your comfort may be secured.

The Chicago Electric Club, 124 Clark street, requests the pleasure of your presence Monday noon, Feb. 20, 1888.

Alternating Current Circuits and Fire Alarm Wires.

To the Editor of The Electrical World:

SIR: As a constant reader of your very valuable journal, I take the liberty of making a few inquiries. We operate an incandescent alternating plant. The capacity of our dynamos is 150 16-volt lamps, current 5 ampères. We use Nos. 6 and 7 B. & S. gauge, double insulated weather-proof wire out of doors, and Nos. 11 and 12 B. & S. underwriters' wire indoors.

I would like to know what loss of current would occur in such a system by induction upon a circuit of twelve miles in length; that is, upon a double circuit, six miles long, running within twelve inches of a naked No. 10 B. & S. fire-alarm wire. The electric light circuit has no grounds, but the fire-alarm (Gamewell system) has. The city authorities desire to go upon our poles with naked wire, as above, and with our 150-light dynamo, 16-volt, lamps we do not know what the loss will be by induction or otherwise, and have appealed to you for any information in the matter that you may give us, and to aid us in deciding what to do.

The authorities claim to have the right to use our poles in any way they deem fit. If we are to be seriously damaged, in case the city can do as it pleases, we would like to know, so that we may take steps to right the matter if we can. H. W. F.

VINCENNES, Ind.

ANSWER—If we understand your case, you would have the outgoing and incoming alternating circuit on the same poles as the fire alarm wire. Now, if the two wires of the alter-

nating circuit be each at the same distance from the fire alarm wire, the induction produced by one will be neutralized by the induction produced by the other, and there will practically be no sensible induction produced, and hence no loss. Even with the two sides of the circuit at unequal distances from the fire alarm wire, but one not nearer than 12 inches from the fire alarm wire there would be but comparatively small loss with a current of 5 ampères. We think that there is nothing to fear from induction in your case, but it is always unwise to string telegraph and electric light wires on the same poles, and, if for no other reason, the city authorities ought to avoid such a proceeding.—EDS. E. W.

The New Armington-Sims Engine.

The Armington & Sims Engine Co., to maintain their position in the electrical lighting field, have brought out an engine especially adapted for those systems where a very high belt speed is required. It is a double-horizontal, double-acting engine and is of striking compactness. Its desirable features are claimed as follows:

1. As to space occupied. Being double-acting it requires but one-half the piston area for same power as the single acting type (that is one taking steam on but one side of piston), and the floor space required is not much greater than the upright engine.

2. Economy of steam. It has the same double ported valve with automatic governor, as their well known standard engines and the results obtained are equal in all respects.

3. Steadiness. The cranks being opposite the parts, they balance each other and a very high speed can be obtained with perfect smoothness of running. This allows the use of small driving wheels.

4. Accessibility of parts. Everything is open and under the eye and care of the engineer. The cut-off regulator on the outside of the wheel is easily accessible and removable, all bearings are easily oiled and examined, and, in fact, everything open to inspection and care.

One of these engines has been put into the new works of the Pond Machine Tool Company, at Plainfield. N. J., where it is driving a plant of the Westinghouse system.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, Feb. 6, 1888.

The Metropolitan Telephone Company.

General Henry S. Huidekoper, vice-president and general manager of the Metropolitan Telephone and Telegraph Company, has resigned both positions. At a meeting of the directors of the company General Huidekoper's resignation was accepted, to take effect on Feb. 15, and Mr. Wm. H. Eckert was elected general manager to fill the vacancy. No election was held to fill the vacancy of vice-president, it being understood that President Vail will unite the duties of that office with his own. Mr. Eckert, who is a brother of Gen. Thomas T. Eckert, of the Western Union Telegraph Company, is well known to every telephone man, and will receive many congratulations upon his election. General Huidekoper will remain a director of the company, as well as a member of the executive committee.

The Board of Electrical Control.

Commissioner Gibbens, of the Board of Electrical Control, has addressed an open letter to Mayor Hewitt on the subject of his failure to have the poles and wires condemned by the board removed from the streets. Mr. Gibbens says that last year the subway law was changed at the request of the city authorities in such a way as to transfer to them the duty of making the enforcement of the law possible, and now it depends entirely upon the Bureau of Incumbrances whether the poles along the line of the subways shall come down or not. "The Board has done its part," says Mr. Gibbens; "now let the city authorities do theirs, so that the electric light companies may be read "a lesson which they will not soon forget."

Rapid Transit Schemes.

It is noticeable that in all the rapid transit plans for New York, electric power plays a leading part, and now Mayor Hewitt, in his comprehensive scheme, which brings the New York Central down to City Hall, gives expression to his faith in electric motors and storage batteries. He not only praises the electric light, but says that the steam locomotive must soon disappear from city limits.

Western Union Book-keepers.

Many of the forty employés of the book-keeping department in the Westeen Union building are said to be dissatisfied with the new rules of Manager English. They object to the system of docking them for time lost in reaching the office. Another rule imposing silence during working hours is objected to. Mr. English to-day said he thought the dissatisfaction was greatly exaggerated. The rules were necessary and must be observed.

The New Consolidated Exchange.

The Tucker Electric Manufacturing Company, 35 Broadway, has secured the contract for wiring the handsome new Consolidated Petroleum Exchange building, on lower Broadway. The exchange proper will be wired for 500 incandescents of 16 c. p., and the other parts will be wired for 400 more. Grimshaw wire will be used for this work to the extent of 40,000 feet. The Tucker Company are finishing a 500 16 c. p. plant for the Glen Cove, L. I., Manufacturing Company, with two Mather dynamos of 250 lights each. This contract takes 10,000 feet of Grimshaw wire.

The Thomson-Houston Electric Company's New Offices.

The Thomson-Houston Electric Company, which has hitherto had its offices in this city with the Sawyer-Man Company in the Mutual Life building, Nassau street, has removed, and has taken quarters in the Boreel building, 115 Broadway, Room 48, where Mr. G. N. Curtis and staff are already busily engaged attending to the large local business of the company. I understand that a working arrangement has been made between the Thomson-Houston and Bentley-Knight companies, by which the former will, through its three hundred sub-companies, push the latter's electric railway system, now attracting so much attention. A representative of the Thomson-Houston Company, in Europe, writes as follows: "It may interest you to know that we have within the past month been given the contract to light the St. Pancras Station of the Midland Railway in London, which is said to be the largest railway station in the world. We start there with 35 2,000 c. p. lamps for the depot proper, and it is expected that out of that will grow a large installation. Something over a year ago we placed a 45-light 1,200 c. p. plant with the Messrs. Tasker's Sons & Co., of Sheffield, who have an immense metal business in that city, besides having the monopoly of the telephone business and practically that of electric lighting. They were so well satisfied with the action of the first apparatus that they have lately ordered three 50-light 2,000 c. p. machines, and the apparatus has been placed in running order. The central lighting station at Taunton, England, of this system, which was placed considerably more than a year ago, has been very successful, and they have now about 100 arc lights in successful operation, not only for the lighting of stores and other interiors, but they have a valuable concession and contract for the lighting of the streets of that town. Mr. Massingham, who is principally interested in the Taunton Company, has secured the necessary capital as well as rights of way, and has placed a station of this system at Weston-super-Mare and Exeter. Installations of this system are also being placed at various other points in England; therefore, so far as we are concerned, we feel quite content with the situation. The city of of Waterford, Ireland, is illuminated by this system, and our lights there are being run in somewhat a novel fashion; that is to say, gas engines are being used exclusively for the running of the dynamos, and generally 10 h. p. single cylinder Crossley engines (Otto patent) are being used, each motor running one of our 18 light 1,200 candle-power machines. Three dynamos are now in operation, and others will be placed as soon as the necessary motors and other arrangements can be made. The total capacity of the station will be 13 gas engines running as many dynamos. The gas for the running of the engines is manufactured by the same company near by, therefore the cost for fuel is reduced to a very minimum. In Glasgow the contract for lighting the New City Hall and Bazaar connected therewith has lately been awarded to this system, and the illumination is to be by arc lights. This will require about 40 lamps. You will probably have noticed references to this in late English electrical papers, as well as the fact that the lighting of the Art Galleries at the Exhibition to be held in Glasgow the current year has also been awarded to this system, and arc lights will be employed also for that purpose. Business on the Continent is progressing favorably at many points, but the most important just at present is at Milan, where the Societa Generale Italiana di Elettricita are materially increasing their street illumination, as they have lately received orders to replace all Siemens arc lights with Thomson-Houston. As I have before informed you, they have in that city already upon the streets 120 of our 2,000 c. p. arc lights, and 45 1,200 c. p. for interior use. They have lately ordered two 35 light 2,000 c. p. machines, and it is expected that they will duplicate this order very shortly. There are other places where we are increasing our business."

A New Differential Arc Lamp.

I saw last week in operation at 18 Vesey street, the offices of A. C. Manning & Co., agents for the Otto gas engine, a new differential arc lamp. Mr. E. Imhauser, of 206 Broadway, is exhibiting there the Lahmeyer compound wound dynamo, running 40 incandescents of 16 c. p., 110 volts and nine-tenths ampère, Edison "specials;" and the arc lamp is in a separate circuit from the same machine. It takes 45 volts and 8 ampères, and there is a resistance of German silver between it and the dynamo. The lamp has two solenoids, which carry the carbon rods by means of silk cords over pulleys and balance weights at the top, the rods running through the solenoids. The light is steady and no flicker or hissing could be detected, and no external magnetic influence is perceptible.

A Postal Telegraph Line Sold.

The Postal Telegraph and Cable Company's property in Maryland has been sold by auction to Mr. James N. Jameson, of New York, for $30,000, the original cost being $91,000. It is believed the purchase was made for the Long Distance Telephone Company, of New York. The lines extend from the borders of Maryland and Pennsylvania to the District of Columbia, and are of the heavy copper wire needed for long-distance telephoning.

The E. M. F.'s.

The first annual dinner of the employés of the United States Illuminating Company was held at the Hotel Hungaria, on Feb. 1. The committee of arrangements consisted of Mr. Strong, chairman: Mr. W. J. Billings, Treasurer, and Messrs. S. Van Ranst, F. Walters, F. Smith and J. Dale. In the absence of Mr. Strong, the chair was taken by Mr. Billings. Among those present, in addition to the committee as above, were Messrs. F. Smith, J. Dale, W. Emmett, F. F. Merritt. J. H. Greacon, M. Kellon, W. Rowe, E. S. Denich, J. Alfke, J. Billings, S. Fischer, F. Walters, J. Simons, F. Bennett, W. Wheeler, D. V. Smith. S. Billings, L. Johnson, J. Conboy, C. O. Smith, H. Ockerhausen, electrician of the New York Ferry Company; Mr. E. P. Hopkins, of the Teleseme Company, and Mr. T. C. Martin. A telegram of regret was received from Mr. O'Shea, who was unable to attend on account of illness. The toast of the "E. M. F." was first given, and was followed by that of THE ELECTRICAL WORLD, which was responded to by Mr. Martin. Mr. F. Bennett delivered a very neat speech on the "Future of Electricity;" Mr. Rowe gave a few words on "Steam;" Mr. E. P. Hopkins spoke of the teleseme; Mr. Denich described the telephone service, and Mr. Kellon replied for the ladies. Mr. Kellon, seconded by Mr. F. Johnson, proposed the health of the committee, which was responded to by Mr. Walters, who expressed the hope and belief that the E. M. F. would become a permanent organization. The proceedings were also enlivened by music, including a violin solo by Mr. Bennett, a recitation by Mr. Wheeler, and songs by Messrs. J. Dale, S. Billings, F. Smith, W. J. Billings and F. F. Merritt. A very pleasant evening was spent, and the company dispersed between 3 and 4 A.M., after singing "Auld Lang Syne" and "Home Sweet Home." W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
48 Congress Street, Boston, Feb. 6, 1888.

Personals.

Mr. George F. Porter, of the Faraday Carbon Company, has been in Boston since last Saturday. Mr. Porter deserves the thanks of Eastern people who purpose attending the Pittsburgh Convention for his arduous efforts in obtaining reduced rates and extra accommodations for the electrical fraternity and others to and from that city from Boston and New York.

Mr. M. E. Baird, for a long time traveling agent for Messrs. Holmes, Booth & Haydens, is now employed by the Eddy Electric Manufacturing Company, of Hartford, Conn., manufacturers of automatic electric motors and electro-plating machines.

Mr. J. W. Godfrey, of New York, the general manager of the New York Insulated Wire Company, accompanied by Mr. George R. Herrick, also of your city, was in Boston on Saturday, and both gentlemen were guests at the rooms of the Boston Electric Club during their stay at the "Hub."

Lectures on Electricity.

Prof. A. E. Dolbear, of telephone fame, professor of physics and astronomy in Tufts' College, will deliver a course of 20 lectures upon the origin, distribution and utilization of electricity, at College Hill, Mass. The lectures will be given at 10:30 A. M. on Mondays, Fridays and Saturdays, beginning Monday Feb. 20. A limited number of tickets will be issued, which can be had upon application to President E. H. Capen or Professor Dolbear, College Hill.

Lighting the Hoosac Tunnel.

About fifty workmen are engaged in putting the Westinghouse converter system in the Hoosac Tunnel, the completion of which work has been retarded from several causes. Workmen find frost and ice in the ground outside the rail, where excavations are to be made for conduits, extending about a mile from each portal. This is an unexpected obstacle to overcome, as observations of previous years place the frost line only about half a mile from the portals. Then the men have imperative orders to cease work as soon as a train is heard approaching and to seek safety in the manholes on the sides of the tunnel. They are also compelled to remain there until the smoke partially clears away. The distance to and from work also helps to materially delay the completion of the work. John A. Grear, superintendent of the work, says conduits will be laid from the west portal, about 11,500 feet, but from the east only about 1,000 feet. These conduits are of three-quarter inch Canadian pine, seasoned three years, soaked in tar and oil compound, and painted with tar outside before laying in the trench. This excludes all moisture. The wire used is from the Standard Underground Cable Company of Pittsburgh. About sixty miles of wire will be used for main cable and lamp connections. The lamps are to be hung on the side walls of the tunnel about six feet from the top of the rails. There will be 1,250 lamps of twenty-five candlepower each, fastened to the wall by Ahlstrom's expansion bolt. Workmen are now drilling holes for the bolts near the west portal. On account of the sulphurous gases and moisture, all metallic work on the lamps is done away with as far as possible, or securely protected. The work will occupy considerable time yet, although the contract calls for its completion by Feb. 1.

Mexican Telephone Gaining Ground.

Mexican telephone was firm at 1¼. The general manager writes confirming the telegram of the 17th inst. in relation to the recent decision by the court in the company's favor. "The opposition," he says, "is thoroughly disheartened and with a territory free from invasion and the extraordinary expense of litigation at an end, together with many applications for renewal of telephonic communication from old subscribers makes our prospects for a successful year exceedingly gratifying."

Electric Lights in Hyde Park.

Advices from Hyde Park, Mass., report that the advisory committee, which has had in charge the matter of furnishing electric lights for street purposes, passed a vote Friday evening, Feb. 4, to the effect that the contract has been complied with in a satisfactory manner, and recommending the selectmen to accept the same, if, upon investigation, they find the plant to comply with the contract. The promoters of this electric light enterprise speak in high terms of the conductors used by them in the installation of their plant. The "Simplex" wire is used exclusively for the electric light connections in Hyde Park.

Electric Lighting Abroad.

The Glasgow, Scotland, Exposition Building, which will be opened in the spring of the present year, will have its art galleries lighted by the arc and incandescent systems of the Thomson-Houston Electric Company. The Thomson-Houston International Electric Company, through its Hamburg, Germany, office, has issued an attractive catalogue, handsomely illustrated and printed on the best grade of paper. The publication evinces great care and excellent judgment in its preparation. It gives a complete and comprehensive description of the various systems of the Thomson-Houston Company.

A Model Isolated Plant.

The Park Central Hotel, Hartford, Conn., has been fitted up throughout with incandescent electric lights of the Sawyer-Man system. A Hartford paper, speaking of the plant, says: "Mr. W. Ketchum, proprietor of the Park Central Hotel, is one of the proudest men in Hartford, as he has recently been hard at work putting in an electric light plant in his house. The engine was running for the first time last evening. The engine is a Payne automatic, made in Elmira, N. Y., and is of 30 horse-power. It runs 175 incandescent lights of 16 c. p., and every room, hall and closet in the whole building is lighted by them. The light is a clear, steady one, and perfectly satisfactory. Besides running the lights, the engine furnishes power to the elevator, washing machine, ice cream freezer, grindstone and other articles."

A Successful Electric Light Enterprise.

The Hartford, Conn., Light and Power Company has been about one year in business and is to-day enjoying a profitable patronage. Its station is equipped with the following named apparatus: Six Westinghouse engines, aggregating 500 h. p.; twenty boilers, with an aggregate of 2,000 h. p.; four Westinghouse alternating current dynamos, with a total lighting (in

candescent) capacity of 3,000 lights; two Mather incandescent dynamos, with a total lighting capacity of 1,000 lights, and eleven electric motors, having a total aggregate of 40 h. p., comprising Sprague, Mather and Eddy motors. In addition to furnishing incandescent electric lights and electric power, the company supplies steam through street pipes for heat and power. The officers of the company are: Mr. David Henney, president and treasurer; Mr. George L. Best, secretary; Mr. Wm. R. White, superintendent electrical department, and Mr. John Henney, superintendent steam department.

An Interesting Lecture.

From the Springfield, Mass., *Daily Republican*, Jan. 14, I clip the following: Alexander P. Wright, superintendent of the electric light company, gave an informal but interesting talk on electric lighting before the Holland Chautauqua circle at Trinity Church last evening. The speaker reviewed the history of electric lighting and electricity from the time Sir Humphrey Davy experimented with voltaic electricity in 1807. He told how Albemarle street at London was lighted by electricity in 1809, and how Starr and King made the first incandescent lamp in 1845. The speaker referred to the principles of the leading electric lighting systems, and explained the process of making the electric current. The talk was conversational in its style, and Mr. Wright's long experience in practical electrical work made the lecture thoroughly enjoyable.

Erie Telephone Dividend.

The Erie Telephone's fifteenth quarterly dividend of three-quarters of 1 per cent. is payable Feb. 15, to stockholders of record Feb 4, at noon, transfer books closing from the last-named date to Feb. 15, at 9 A. M.

W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., Feb. 6, 1888.

James W. Queen & Co.,

of this city, expect shortly to have a full stock of Ayrton & Perry's new measuring instruments, which were described a few weeks ago. They have received a letter stating that the instruments would be placed on the market as soon as possible. Messrs. Queen & Co. are the sole agents in this country for the Ayrton & Perry instruments.

H. M. Sciple & Co.

The partnership heretofore existing between H. M. Sciple and Thomas P. Conard, under the firm name of H. M. Sciple & Co., engines and boilers, at Third and Arch streets, has been dissolved by mutual consent. The business will be continued by Mr. Conard. Mr. Sciple will devote his entire attention to his pump business.

The Parts Electric Battery Company

have suffered considerably from their inability to procure a sufficient supply of glassware, on account of the strike among the flint-glass workers. Their business has reached such proportions that the delay in obtaining jars is very annoying.

The Lehigh Avenue Railway.

When the Lehigh Avenue Railway, which is now in course of construction, is put in operation, electricity will be the motive power employed. The company has completed its tracks from Fairmount Park to Second street, with the exception of about a quarter of a mile of double track in the vicinity of its intersection with the connecting railroad near Seventeenth street. The intention to avoid all grade crossings will delay the completion of of this portion of the line until it is finally determined whether to place the grade over or under the present railroad crossing at that point. The Wharton motor (Reckenzaun), which has been so successful in the numerous tests recently made, will be used on the road. The Wharton Company are building cars as fast as possible, and have just completed an eight-wheel car, equipped with two motors of 15 h. p. each, incandescent lights, electric heater, and every possible convenience. This car will probably be given a trial trip on some of the lengthy street roads of this city before long.

Main Belting Company.

The Main Belting Company report an unusually good trade for this season of the year. Secretary Plummer says that while the strikes now in progress in the mining districts may have held back some orders from furnaces and similar establishments in that section, there has been no decrease in the business.

A Storekeepers' Co-Operative Plant.

It is said that the storekeepers on the west side of Front street, between Susquehanna avenue and Dauphin street, the major portion of whom have their stores illuminated with the electric light, have been discussing for some time the advisability of manufacturing electricity for their own use. They claim that the price charged for one electric light (60 cents a night) is entirely too much, and have figured it out that they can manufacture it themselves at one-third the price charged now. Accordingly, a meeting to perfect an organization will soon be held. It is proposed that each storekeeper be assessed $150 to purchase a building and the necessary plant.

Telephone Taxes.

A dispatch from Harrisburg says that the American Bell Telephone Company is resisting the payment of tax on its capital stock for 1884, 1885 and 1886, amounting to about $20,000, and last Wednesday argument was had in the court of the county on an appeal made by the corporation. Wayne MacVeagh, Samuel B. Huey and M. E. Olmstead represented the defendant and Attorney-General Kirkpatrick the State. Counsel for the company maintained that it did no business in Pennsylvania, simply leasing telephones to corporations in this State, which paid their taxes. The Attorney General said the company had an interest in these telephones, and consequently was taxable. The decision was reserved.

The International Printing Telegraph Company.

There was a private exhibition given last Wednesday by the International Printing Telegraph Company at their office, No. 417 Walnut street. The instruments, which are covered by patents, are simple in construction and operation. The machine consists of several small electro-magnets, so arranged as to move a wheel containing the letters of the alphabet to a point on paper, which is held in place in front of the operator as in an ordinary type-writing machine. The machine itself is a combination of the type-writer and stock "ticker," so simplified that any one can operate it by simply pressing the keys or buttons on which are the letters of the alphabet.

The message transmitted is printed on a letter sheet under the eye of the operator, and any mistake is at once discovered and may be corrected. The message telegraphed is delivered from the instrument to the recipient in clear type-written characters at the rate of sixty words per minute. The message may be sent at any time, whether the office in which it is received is closed or open, and is received on paper fed from a roll which works automatically and sends a signal to the operator when the paper carriage returns to its initial point.

The instruments are to be connected with a central station after the plan of the present telephone system, and connections are then to be made which guarantee absolute privacy. The answer can be at once returned, as by simply turning a switch the transmitter is made a receiver. No batteries are required in the subscribers' offices, as the central office supplies all the electrical power necessary to run the instruments.

In the tests two instruments were used which were first divided by an artificial line representing ten miles of wire. After several messages had been transmitted by the invited guests a connection was made with Pottsville. A message was sent to a business man there and an answer was received immediately. The instruments were then connected with a circuit representing six hundred miles in length and the replies received were as plain as those recorded when only ten miles intervened between the instruments. The cost of the machines is said to be less than the telephones now in use and their adaptation to long as well as short distances was proved at the tests given. Thomas Cochran is the president of the company, J. H. Linville, the electrician, is vice-president, and August Boyd secretary and treasurer and D. C. Ferris general manager.

The Baxter Company, Baltimore.

In Baltimore, at the corner of Chester and Biddle streets, a large force of men have been engaged laying heavy foundations for the new buildings of the Baxter Electric Manufacturing and Motor Company. At present two brick buildings will be erected, the first at the corner of Biddle and Chester streets. It has a front of 60 feet and a depth of 320 feet to Chase street. It will be two stories in height. Mr. Benson W. Greene, the president, says the new buildings and plant will cost $100,000.

Kensington Feed Water Heater.

The Kensington Engine Company, Limited, are making preparations for building a new feed water heater, which they expect to have ready for the market within the next 60 days.

E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, Feb. 4, 1888.

Doings in the City Council.

In the City Council last week it was announced that the Wheeler Reflector Company had accepted the contract to light certain streets with light other than gas at $1.64 per lamp.

The Inter-State Telephone Company.

A communication from the Inter-State Telephone Company, Charles W. Partridge, President, was read, stating that it had a telephone patent that infringed on no others and was superior to the Bell, and asking that it be allowed to erect lines and put up instruments in Chicago, and offering to supply the telephones at $60 per annum each. Referred to Committee on Fire and Water.

Comments on Poor Gas.

The *Tribune* last week devoted a considerable amount of space to showing how bad gas is made and the gas bill to the consumer increased by the augmentation of the pressure which causes the gas to flow through the meter faster than it used to do, and yet give a poorer light, owing to the nitrogen.

The Electrical Supply Company.

The Electrical Supply Company have recently put on the market a new wood box bell of very handsome design, and embodying some new principles in construction. The box is made in four different kinds of woods—oak, ash, walnut and cherry. Mr. Fred. De Land, who has been with the company a number of years, recently packed up a nice line of samples and is representing the interests of the firm as traveling salesman in Ohio, Michigan, Wisconsin, Illinois and other States. He reports good success so far.

The Heisler Plant at Ogden City, Utah.

The Heisler Electric Light Company, of St. Louis, have just received a flattering letter regarding their a long-distance incandescent system from President David F. Walker, of the Ogden City Electric Light Company. The Ogden Company is operating the Heisler system, having about 300 30 candle-power lights in operation. Mr. Walker gives the experience of his company as follows:

"In reply to your favor of Dec. 21, I would say we have run nearly six months without interruption worth speaking of. The lights are brilliant and maintain their guaranteed candle-power and the full life of the lamps. Our lighting station is situated in Ogden Cañon, about six miles from the centre of Ogden City. We run by water-power, and have about thirty miles of line wire circuits. The wire is ample in size (No. 9 B. & S. gauge), and we find the loss of E. M. F. very slight. The last lamp on the circuit burns just as brightly as the pilot lamps at the station. We tested the dynamo and found it worked up to the capacity you guaranteed, namely, 340 30 candle-power lights; also tested the candle-power of the lamps, and each proved fully thirty c. p. In fact, we find the system reliable and the lights very brilliant, a beautiful color, and everything equal to our entire satisfaction."

Cable or Elevated System.

The West Chicago Street Railroad Company has set apart $2,000,000 of stock for the purpose of providing the line with an improved motor, and is bound by an agreement to select within a year either the cable or the electric system—whichever may be considered the best and cheapest. A large proportion of the $10,000,000 stock of the company is to be placed outside the city, and some 7,000 shares have already been marketed in the East. It is understood that this $2,000,000 will be sold in Chicago, if possible. There is considerable secrecy as to the financial operations of the gas and street railway companies, but it is believed that a larger proportion of this company's stock than was expected when the road changed hands has gone into the hands of Chicago capitalists. Marshall Field is known to be a heavy owner, and others who sold out the stock of the old company have bought into the new one.

Mr. S. A. Barton,

the general manager of the Thomson-Houston Electric Company, has returned home from a four weeks' sojourn in the East. He was impressed with the wonderful growth of the electric lighting business among the various competing companies, and with the evidences of prosperity on the part of local and manufacturing companies. He finds his own company occupying, with the recent additions, three acres of floor space, employing nearly 1,200 men, all told, and in addition to its large arc lighting and motor business turning out about 7,000 incandescent lamps per week, which will, he says, soon be increased to 3,500 per day.

The Central Electric Company.

The pin and bracket trade of this company is materially increasing, a large number of orders having been received during the past week. I am informed that when this class of trade makes a start it is a pretty sure indication of the revival of business in general. This company has recently invented and is putting on the market a new iron box bell having a solid back, and claimed to be entirely dust-proof. Their traveling salesman, Mr. Low, reports good sales so far.

Telephone Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$160@	$165	Iowa Union	$25@	$26
Central Union	44@	45	Michigan	75@	76
Chicago	360@	370	Missouri and Kansas	68@	69
Colorado	19@	21	Rocky Mountain Bell	40@	45
Cumberland	62@	65	Wisconsin	108@	109
Great Southern	30@	32			

E. L. P.

ENGLISH NOTES.

LONDON, Jan. 18, 1888.

Mr. Graves' Statistics of the Telegraph.

The address delivered by Mr. Edward Graves, the new president of the Society of Telegraph Engineers and Electricians, will be read with considerable interest by telegraph men all the world over, for although it is not characterized by any startling generalization or by the announcement of any striking novelties, it yet furnishes a clear, telling and concise epitome of the position and achievements of what is still by far the greatest practical application of the electric current. The statistics furnished by Mr. Graves as regards the amount of telegraph business transacted in the chief cities of this country bears striking evidence of the extent to which the employment of the telegraph is dependent on the local peculiarities of the town in question. In this comparison it is at once seen that the seaport towns contribute by far the largest share, in proportion to their population, of the telegraph revenue of the country. For instance, Newport with a population of 40,000, sends just half as many messages as Leeds, with a population of 300,000, while Cardiff, with 115,000 inhabitants, deals with two-thirds as many messages per annum as Birmingham with a population of 420,000. Another local feature which vastly influences the telegraph returns is that of race meetings. Many a town of small population, where race meetings are held two or three times in a year, considerably outdistances far more important commercial centres in the amount of its telegraphic traffic.

Mr. Graves' address would perhaps have come with additional force and interest a year or two hence, for it must be admitted that the celebration of the telegraph jubilee during the last Summer has somewhat forestalled the general interest in this subject. It is therefore all the more to the President's credit that in the face of this difficulty he should have acquitted himself in so successful a manner.

The Price of Copper.

It seems to be the general opinion in this country that the price of copper is likely to be sustained at or near its present level for a considerable time to come. It happens, however, that quite a large number of the leading electrical companies at the present time hold large stocks of copper. Consequently they are likely in the first instance to benefit by the rise in values.

The Telephone as a Substitute for Speaking Tubes.

The use of the telephone as a substitute for speaking tubes is rapidly extending in this country. It needs hardly to be said that this is not due to the action of the United Telephone Company, whose system of rental is by no means adapted to foster business of this class. There are, however, three companies in the field, each of whom is now doing a fair amount of business and who are employing instruments which they claim to be free from the Bell and Edison patents. In all three cases the receivers employed are of the description known in this country as the *English Mechanic* type, which consists of a flexible non-metallic diaphragm with a soft iron armature in the centre. Your readers are probably aware that Bell had to disclaim this instrument owing to disclosure of the principle in the columns of the *English Mechanic*. The Stanhope Company employ a similar instrument, both for transmitter and receiver. The articulation is very clear, but the system evidently is not well adapted for long-distance transmission.

The New Telephone Company work under the patents granted to Prof. S. P. Thompson. Their transmitter is of the type known as the valve telephone, in which the microphone consists of a ball of carbon resting upon three points, at the extremity of a short speaking tube. These instruments give considerable satisfaction.

The remaining company, which calls itself the "Equitable Telephone Association," employs a carbon transmitter, which is mounted on a leaden frame hung loosely from a wooden support by loops of gutta percha. The object of this arrangement is of course to circumvent the Edison patent, and they claim that no diaphragm is employed. The instrument works very well indeed. Mr. Swinton, the manager of the company, has recently introduced a simple switch-board, which is placed beside each telephone, enabling a single plug connection to establish communication with any other telephone on the circuit. For *x* telephones

$x + 2$ lines are required. The company has just fitted several warehouses in the city with this system, and is now putting in an installation in a large building where twenty-seven separate floors will be connected.

The Menges Thermo-Magnetic Motor.

The thermo-magnetic motor of M. Menges is attracting a good deal of attention here, and the general opinion appears to be that it is fair to hope for results of an important character. The English electricians are, it is to be feared, allowing themselves to be left a little in the rear in the practical development of what may perhaps be regarded as the great hope of the future—the direct conversion of heat into electrical energy. On your side of the water you have Edison, Berliner, Willard E. Case and Acheson engaged on the question; Holland, for once in a way, takes a prominent position with M. Menges, and in France theoretical investigations on the thermo-magnetic properties of iron have recently been carried out both by M. Berson and by M. Ledeboer. In this country, however, Mr. Herbert Tomlinson has for a long while been engaged in some remarkably interesting studies on the various molecular changes which iron undergoes at different temperatures. And, after all, we can once again lay claim to the fundamental *theoretical* discoveries upon which much of the present practical work is based. For in 1868 Dr. George Gore, of Birmingham, brought before the Royal Society a very beautiful experiment showing the generation of the electric current by varying the temperature of magnetized iron wire. The iron wire passes through the centre of a solenoid of fine wire and rests at its two ends upon the poles of a U-shaped permanent magnet. It is, however, electrically insulated from the magnet, and a powerful current from an independent source is sent through the wire, raising it to a red heat. The fine wire coil of the solenoid is connected with a delicate galvanometer. Under these circumstances, when the heating current is switched on and off an induced current is generated in the solenoid, which is indicated by the throw of the galvanometer needle. It will be seen that as the heating current passes longitudinally through the coil it can have no direct inductive influence, and, in fact, when a non-magnetic metal is substituted for the iron wire no induced current is obtained. This makes a very pretty lecture experiment in illustration of the principle of the thermo-magnetic generator. This is by no means the only contribution of Dr. Gore to the early investigation of this subject. At the Loan Collection of Scientific Apparatus, exhibited at South Kensington, in 1874, Dr. Gore showed other appliances for the same purpose.

Electric Light Legislation.

There can be little doubt that the forthcoming Parliamentary session will witness the passage of a bill repealing the electric lighting act of 1882, which has had so disastrous an influence upon the electrical industries of this country. It is at least certain that what is known as the "confiscation" clause will be done away with, and it is not improbable that the failure to deal with the subject in the last session, which was so much a matter of regret at the time, will now result in the grant of better terms than would then have been obtained. It is, however, yet too early to feel any degree of certainty on this point, and we must not cry before we are out of the wood. It is true that the leaders of the government are profuse in their promises that the session shall be devoted to dealing with the long arrears of English legislation, but the Irish faction has proved itself so formidable in the past, that it may well be that the good intentions of the government may once more be brought to naught. While on this subject, I may note that the electricians in this country are not entirely agreed that, as things have turned out, the passage of the act has proved injurious to their interests. The result has been that such central station lighting as has been carried out up to the present has chiefly been accomplished by means of overhead wires, with the result that the local authorities have had no *locus standi* in the matter and the companies have been left alone to carry out their plans in their own way, and probably they have done better than they would have done if hampered by the interference of the local authorities.

Alternating Current Patents in England.

Considerable curiosity is felt in many circles to learn what are the intentions of the Westinghouse Company with regard to their English patents. They have as yet made no sign of life and it is not clearly understood what are their relations with the Gaulard-Gibbs Company. This latter company is also perfectly quiescent. It may probably be taken for granted that nothing will be heard from either source until the conclusion of the pending action with the Grosvenor Gallery Lighting Company.

THE TELEGRAPH.

Alabama.—A company, in which Mr. A. Whited is interested, has been formed to build a telegraph line from New Hope to Whitesburg.

Pacific Railroad Telegraphs.—A favorable report has been ordered by the House Post-Office Committee on Representative Anderson's bill requiring the subsidized railroad companies to afford equal facilities to all telegraph companies.

Boston Telegraphers' Ball.—The third annual ball of the Boston Telegraphers' Mutual Aid and Literary Society was held last week, at the Odd Fellows' Hall, Boston, and was a brilliant success. It was attended by telegraphers from all parts of the country.

Anglo-American Cable.—The half-yearly meeting of the Anglo-American Telegraph Company was held in London on Feb. 3. Lord Monck said that the year 1886 had produced a gain of 162 per cent. in the business done in the same period in 1885 at the higher rate, and for 1887 over the previous year, 12 per cent. He was hopeful of better rates from the new conference with the Commercial Cable Company. Lord Monck spoke in flattering terms of the repair of the 1869 Brest-St. Pierre cable by Capt. Trott, of the "Minia" (recently in New York). A vote of thanks was unanimously carried, and it was also suggested that a handsome remuneration should be given to Capt. Trott, as one "whose work had considerably increased the value of teleegraph securities."

Fire-Alarm Telegraphs.—Speaking of the great need of an electric fire alarm telegraph system in the town, the Laramie (Wy.) *Boomerang* says: "Even if it does cost a few hundred dollars, it is an indispensable necessity. A single flying spark, any day or night, may kindle a blaze in this town; a few minutes' delay in running around the streets hunting the fire may give it a start so that it will be beyond the power of the department to check it until thousands of dollars worth of property is destroyed and perhaps some important industry seriously crippled, or some big institution obliterated. It is time to think seriously of this matter." That is the matter in a nutshell. The cost of an electric alarm system is so small in comparison with the added protection against loss by fire which it affords, that no town of any appreciable size can afford to be without one.—*Fire and Water.*

THE TELEPHONE.

Chicago, Ill.—The case of the Chicago Telephone Company *vs.* The Commercial Quotation Company has been decided in favor of the former corporation. The plaintiff claimed $15.62, as one-half of the rental for the last quarter for the use of a telephone which was ordered out by the defendant because of inefficiency of service.

New Orleans, La.—Judge Todd, in the Supreme Court of Louisiana, has rendered a decision in the case of City of New Orleans *vs.* The Great Southern Telephone and Telegraph Company, on appeal, affirming the decision of the lower court, that an annual charge of $5 per pole upon the poles of a telephone company already established, imposed by a municipal ordinance as a "consideration for the privilege," is not a tax on property, or as a license, and cannot be sustained as an exercise of the taxing power. Neither is it an exercise of the police power, and the imposition of the additional and burdensome consideration here involved is not within the scope of the rights reserved.

The McDonough Case.—A special dispatch from Washington of Feb. 1 says: The hearing upon the petition of J. W. McDonough, for a re opening of the case in which Alexander Graham Bell was granted a patent for the speaking telephone was begun to-day before the Commissioners of Patents. The case has been before the Department about a year and a half, and involves the question of priority of invention of the speaking telephone. Colonel Robert G. Ingersoll, of New York; Frank Hurd, of Ohio; Judge D. Humphreys, of New York; W. C. Strawbridge, of Philadelphia, and H. H. Eldred, of New York, appeared as counsel for McDonough, and J. J. Storrow, of Boston; Roscoe Conkling and L. W. Serrell, of New York, as counsel for Bell. It is expected that the hearing will occupy the remainder of the week.

THE ELECTRIC LIGHT.

Fulton, N. Y., will have a Schuyler plant.

Osage City, Kan., is to have an electric light plant.

South Boston, Va.—A company has been organized for electric lighting.

Bloomington, Ill.—The electric light plant is to use crude petroleum for fuel.

Monticello, Ill.—The Monticello Electric Light Company has a franchise for one year.

Sherman, Tex.—The city council has secured a number of estimates for an electric light plant.

Clinton, Mass.—The Clinton Gas Light Company has a Schuyler plant, with Brady mast arms.

McKeesport, Pa.—The McKeesport Gas Company has made up its mind to do incandescent electric lighting.

Yarmouth, N. S.—A local electric lighting company, with a capital stock of $15,000, is now lighting Yarmouth.

Norristown, Pa.—The Richter Electric Light Company, of Camden, N. J., is, it is said, to put in a plant at Norristown.

Ada, O.—Mr. F. L. Bauman and others have incorporated the Ada Electric Light Company with a capital stock of $10,000.

Ann Arbor, Mich.—An electric light plant is proposed for Ann Arbor, by S. E Parkhill and A. Todd, of Oswosso, Mich.

Athens, Tenn.—The Athens Mining and Manufacturing Company, Mr. R. J. Fisher manager, proposes to put in a plant at an early day.

Lima, O.—The Lima Electric and Motor Power Company has been awarded a year's contract for public lighting at the rate of $58 per lamp.

Paris, Me.—The Paris Edison Electric Light Company has been incorporated by J. C. Fincklin and others, with a capital stock of $10,000.

Scranton, Pa.—The Suburban Electric Light Company of Scranton has been incorporated by W. J. Lewis and others, with a capital stock of $10,000.

Helena, Ark.—The Helena Electric Light and Power Company, with a capital of $25,000, has been organized by J. Summers, L. Berton and others.

Osakis, Minn.—Messrs. Schoi & Chalfant, millers, at Osakis, are to put in a 100-light Waterhouse plant and will light the neighboring stores and residences.

Lancaster, Pa.—The proposals for lighting part of Lancaster by electricity are receivable by Mr. W. Riddle, chairman of the lamp committee, until Feb. 17.

Syracuse, N. Y.—Mr. J. C. Keefe, secretary of the Syracuse Electric Light Company, reports about 500 arc lights and 1,200 incandescents in use, besides motors.

Sauk Centre, Minn.—An electric lighting franchise for 15 years has been granted to Mr. H. Keller, who agrees to furnish lights, it is said, at $1.50 per month.

Fayetteville, Ark.—The Fayetteville Electric Light and Power Company has been organized by E. B. Harrison and others, with a capital stock of $30,000.

Easton, Pa.—It is said that several families on College Hill have inquired whether electricity for incandescent light, for private use, could be obtained from the electric road.—*Easton Free Press.*

Little Rock, Ark.—Mr. W. G. Whipple, Mayor of Little Rock, wishes to receive proposals for from 15 to 60 arc lights and 300 incandescents, and operating the plant for two years from the date of the contract.

Lansing, Mich.—It was proposed to put in a city plant at Lansing, but as the electric light company has spent $20,000 on its plant, the Business Men's Association hold that it would be unfair to disturb the existing arrangements.

Bessemer, Ala.—The Bessemer Ice Manufacturing Company has been incorporated with a capital stock of $10,000, by J. H Hard, C. F. Hard, G. M. Wells, A. J. Robinson, H. F. Matthews and F. J. Dinegan to build an ice factory, electric light plant, etc.

Pottstown, Pa.—Mr. H. Wells reports that a charter for the Pottstown Light, Heat and Power Company has just been obtained, but that nothing has been done toward erecting an electric light plant, as that awaits the full organization of the company.

Baltimore, Md.—The Edison Illuminating Company, noted last week in our Philadelphia letter, has been incorporated by Thomas J. Shryock, William A. Dunn, Francis P. Stevens, Robert Turner, William H. Crawford and others. The capital stock is $300,000.

The Edison Convention.—The Association of Edison Illuminating Companies was to hold its semi-annual meeting at the Grand Pacific Hotel, Chicago, on Feb. 8. A special car containing a number of leading Edison men left this city on Tuesday morning.

Competition in Electric Lighting.—At Albany on Feb. 3 Assemblyman O'Connor, of New York, introduced a bill which apparently is intended to promote free competition among electric light companies of this State and to prevent consolidations or pooling of issues.

Houston, Tex.—The contract of the Fort Wayne Jenney Company at Houston is for 100 arc lights for five years. The company are putting in the plant themselves. They will add probably 100 to 150 arcs for commercial lighting, and 2,000 incandescents of their new alternating system.

Decatur, Ala.—Mr. W. H. Fleming, electrical engineer, has just completed an excellent installation at the Tavern, Decatur. It comprises two 250 light incandescent machines of the Thomson-Houston Company, Sawyer-Man lamps being used. The plant is driven by a 60 h. p. Ball engine. Over 300 lamps are placed in the Tavern, the remainder being distributed throughout the adjacent blocks.

Grand Rapids, Mich.—Judge Jackson, in the Circuit Court for the Western Division of Michigan, has just sustained the Edison Electric Light Company in its claim that the Grand Rapids Electric Light and Power Company did not have exclusive rights to run wires in the streets of Grand Rapids. The decision has a general bearing as to rights in streets. Work on the Edison plant is now going forward.

Providence, R. I.—A neat little accumulator plant is in operation for incandescent lighting at the coal yards of Hopkins & Pomroy, Providence. There are 32 cells of the Electrical Accumulator Company's make, charged by a Waterhouse dynamo, in charge of Mr. C. Kimbark. Seventy-two 16 c. p. Schaefer lamps are placed. The plant was planned and installed by Messrs. Geo. H. Thurston & Co., of Providence.

Williamstown, Mass.—An electric lighting company has been organized at Williamstown by C. M. Smith, Keyes Danforth, T. M. Quinn, C. S. Cole and Fred C. Severance. Mr. Cole has been elected president, Mr. Danforth vice-president and C. M. Smith clerk and treasurer, and these officers will constitute the board of directors. Books will be opened at once, and $15,000 in stock is wanted. No plant will be put in until spring.

New York.—The Mount Morris Electric Light Company has got from Judge Andrews a temporary injunction against General Newton, Commissioner of Public Works, and John Richardson, Superintendent of the Bureau of Incumbrances, and an order upon them to show cause why a permanent injunction should not issue to restrain them from removing the lamps and poles erected by the electric light company.

Heisler Plants.—Hyer & Montgomery, New York State agents for the Heisler system, have installed a plant for store lighting at Orange, N. J., of which Mr. R. B. Suckley is the purchaser. They have also installed a 230-light plant, lamps of 30 c. p., at Saugerties, lighting two large new paper mills of J. B. Sheffield & Son. A contract for lighting Red Bank, N. J., with a Hesler plant has been closed by White & Rusling.

APPLICATIONS OF POWER.

Attleboro, Mass.—The Attleboro *Advocate* is now being printed by a 4 h. p. Baxter motor.

Houston, Tex.—Mr. T. W. Anderson will probably erect a large plant to furnish power for an electric railway.

Chattanooga, Tenn.—The Chattanooga Electric Street Railroad Company has received its permit from the city.

Baltimore, Md.—The Yorktown Turnpike Company is seeking powers from the Maryland Legislature to run its cars by electricity.

Waltham Watches Made by Electricity.—The Waltham Watch Company has put in a Baxter motor and is thoroughly pleased with its operation.

San Diego, Cal.—The San Diego *Union* reports enthusiastically on the working of the Electric Rapid Transit Company's road, and of the G street electric road, on both of which cars are now running. In the former case, grades of 8½ per cent. are dealt with.

The Van Depoele System.—It is reported that a syndicate has bought all the rights and inventions connected with the Van Depoele system of electricity, the price paid being $2,000,000, and it is probable that the works, which are now at Chicago, will be removed to Birmingham, Conn.

Washington, D. C.—A bill to incorporate the People's Electric and Cable Railroad Company of the District of Columbia has been introduced into the House of Representatives. The in-

corporators are Andrew G. Curtin, Geo. M. Roads, Wm. Chapman, John A. Woods, James Kane, E. B. Youmans, William Dickson, Albert W. Fletcher, George M. Lockwood, W. A. Han, and H. F. Page.

Alternating Current Motors.—The monthly meeting of the American Institute of Electrical Engineers will be held on Tuesday, Feb. 14, at 8 P. M., at the house of the Society of Civil Engineers, 127 East Twenty-third street, when Dr. Louis Duncan, of Johns Hopkins University, will read a paper on "Alternating Current Motors." The subject is one of unusual importance, and Dr. Duncan's report of his work and investigations in this field will be heard with much interest.

Wilmington, Del.—A special dispatch from Wilmington, of Jan. 26, says: One of the Sprague motor cars on the new electric street car line was given a satisfactory test yesterday afternoon. The connection is made from an overhead wire through the top of the car, the circuit being completed by the wheels and a wire under the rails. A partial test was given the night before, when the car was lighted by electricity. The new line is over two miles long, and runs from the Court House north, and there are numerous heavy grades and curves. Electricity is furnished by the Wilmington Electric Company, which put in a special machine to run the two cars to be placed on the line. The engine is half a mile from the nearest end of the road. The representative of the Sprague Motor Company and the officers of the Wilmington Street Railway Company feel satisfied with the results of the two tests. The date for running the cars regularly has not been determined yet.

PERSONALS.

Mr. Henry M. Whitney, of Boston, says: Electric power has not yet been successfully applied to the street cars in Boston, but that does not disturb my faith in the practicability of such application.

President White, of the Belt Line in Washington, D. C., remarks: I expect to see horses altogether banished from the street car service in the next two years, and their place taken chiefly by electricity.

Mr. Geo. S. Bowen recently entertained at the Elgin, Ill., electric light station the high school and academy faculty and pupils. The visitors were allowed to inspect the machinery in operation, and were given an explanation of the methods adopted for generating and distributing the current.

Mr. J. McColiff, the superintendent of construction of the New England division of the Western Union Telegraph Company, was given a banquet by the operators and linemen in Hartford and New Haven, at the Park Central Hotel, on Jan. 27. The occasion was memorable. During the evening, Mr. McColiff was presented with a purse of $400, as a slight token of the esteem in which he is held. The committee of arrangements consisted of E Ryder, chairman, of Hartford; W. H. Harris, F. Fairchild and E. Fox, of New Haven, and T. H. Goodrich, B. C. Walsh, S. B. Curtis, J. P. Nolan and H. C. Card, of Hartford.

Mr. Preston C. Nason.—A New England correspondent sends us the following: Preston C. Nason, of Boston, one of the early workers of the telephone in the United States, and for several years identified as general manager of various telephone and electric companies in the Spanish West Indies and Santo Domingo, has met with a painful accident that will, in the opinion of the attending surgeon, require many weeks of absolute rest for even a partial recovery. Mr. Nason was at Franklin, Mass., with a gang of workmen superintending the installation of a new hot water and electric system of heating and ventilation, and while passing over an icy crosswalk, stepped on the frozen edge of a slush pool, overturning the right ankle, resulting in the tearing away of the ligature, rupturing a blood vessel and precipitating Mr. Nason heavily upon the pavement. A little fellow, by the aid of his coasting sled, drew the unfortunate gentleman to the residence of the superintendent of the Franklin Water Works, where Dr. Gallison rendered all possible aid to the sufferer.

MISCELLANEOUS NOTES.

Management of Accumulators.—The price of the new book by Sir David Salomons, reviewed last week, is $1.20, and not $1.50 as then stated. The book is of the most practical and useful character, and should be in the hands of all interested in storage batteries.

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Hine & Robertson, 45 Cortlandt street, N. Y., are pursuing a novel method of inducing electric light companies to try "Eureka" Packing. To every new customer ordering direct from them 15 pounds or more at regular price, 75 cents per pound, they will send a handsome 8-day calendar clock, 12 in. dial, 24 in. high, or a set of brass oilers and tray, 6 pieces, the best made. This is an easy way to secure one of these necessary articles and at same time get a packing indorsed by very many prominent electric light plants.

STOCK QUOTATIONS.

The following list, compiled by Mr. J. S. Stanton, 16 and 18 Broad street, gives the current quotations of electrical stocks:

Feb. 6, 1888.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	25	40
Am. Tel. & Cable	72	74
Cen. & So. Am.	96	110
*Com. Tel	.....	.....
*Gold & Stock	93	95
*Inter. Ocean Tel.	84	90
N. Y. Mutual	80	85
Pac. & Atl.	55	65
*Postal T. & C.	25	30
South. & Atl.	66	80
W. U. Tel.	78¼	78½
W. U. Scrip	.....	.....
W. U. Bonds	115	117
Mut. U. Bonds	88¾	89¼
TELEPHONE.		
Am. Bell	227	228
Am. Speaking	110	115
Erie	31	32
*Hudson River	50	55

TELEPHONE.	Bid.	Asked.
Mexican	.....	.....
*N. Y. & N. J.	75	85
N. Y. & Pa.	.....	80
New England	41	42
*Southern Bell	110	140
ELECTRIC LIGHT.		
*Am. Electric	25	35
*Brush	.....	50
*Brush Ill	.....	100
*Consolidated	20	30
*Daft	.....	.....
*Edison	150	160
*Edison Ill	85	87
*Edison Isolated	.....	.....
*United States	28	36
*U. S. Ill	.....	.....
MOTOR.		
*Daft	.....	.....
*Sprague	.....	85

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

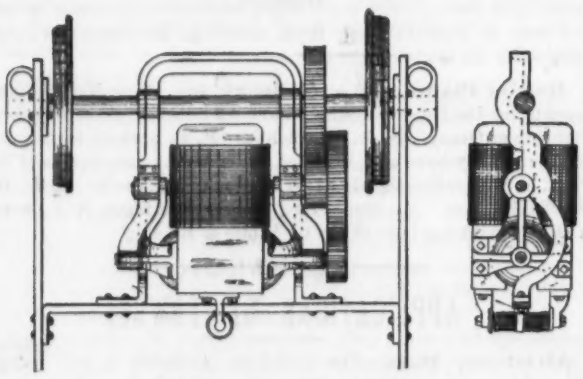
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JANUARY 31, 1888

377,046. Armature for Dynamo-Electric Machines; Edward J. O'Beirne, Elgin, Ill. Application filed March 3, 1887. An insulated cylinder is formed of wire wound upon a sheet metal cylinder having upturned flanges. Bobbins are suitably wound on the cylinder and slats are placed between the bobbins, both upon the inner and outer surface of the cylinder. The above is combined with a wooden cylinder having a cone-shaped inner surface and a hollow shaft having two discs that fit the inner surface of the wooden cylinder, one of the discs being secured to the shaft and the other being adjustably held in position by a nut on the shaft.

377,073. Protecting Device for Electrical Apparatus; Angus S. Hibbard, New York, N. Y., Assignor to the American Bell Telephone Company, Boston, Mass. Application filed May 18, 1887. A strip of non-inflammable insulating material has mounted upon it alternate strips of metal foil and insulating material wound helically. The ends of the metallic strip are connected with the circuit by suitable means. See illustration.

377,083. Electric Auxiliary Signaling System; George F. Milliken, Boston, Mass, and Henry B. Lytle, Providence, R. I., Assignors to the Gamewell Auxiliary Fire Alarm Co., Boston, Mass. Application filed Sept 10, 1887. A system in which private houses or establishments of any kind are connected by local circuits with a



377,230. ELECTRIC MOTOR.

public alarm box, the latter being capable of operation by hand, as usual, or by electro-magnets controlled by the local circuits. The objects are to prevent false alarms, and to provide means for signaling automatically any defects in the system.

377,107. Electric Railway; Rudolph M. Hunter, Philadelphia, Pa. Application filed June 30, 1887. Compartments are provided under the seats of a railway car, the compartments having removable floors or bottoms. These floors support secondary batteries. Detachable locks secure the bottoms in place.

377,110. Telegraph Instrument; William S. Logue, Baltimore, Md. Application filed March 10, 1887. The instrument is a relay for quadruplex telegraphs provided with exciting coils, and a condenser surrounding the coils. There are circuit connections between the condenser terminals and the line to neutralize the effect of the static discharge of the line on the relay. See illustration.

377,118. Insulating Electric Conductors; Rupert Schefbauer, Dresden, Saxony, Germany, Assignor to Weber & Schefbauer, same place. Application filed April 25, 1887. The patent covers both the process and product. The product is a strip of paper containing oxide of copper and having conducting wires embedded therein.

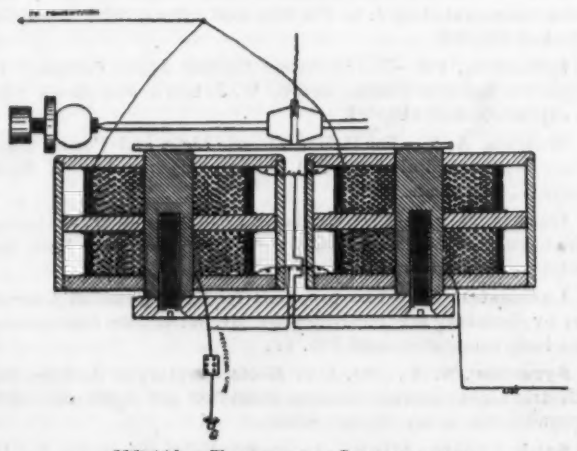
377,210. Electrolyte Compound; George B. Pennock. Application filed Jan. 12, 1887. The compound is mineral wool in combination with acids or fluids of any kind capable of decomposing it.

377,215. Traveling Current Collector for Electric Railway Motor Cars; William M. Schlesinger, Philadelphia, Pa. Application filed Oct. 21, 1886. The invention consists of a collector comprising a frame which is adapted to enter and travel in a conduit slot, a pair of parallel contact brushes secured to the frame, conductors leading from the brushes and encased in the frame, a support for the collector

377,073. PROTECTING DEVICE FOR ELECTRICAL APPARATUS.

frame having a lateral movement, the collector frame having itself an independent movement, both vertical and lateral.

377,217. Alternating Current Motive and Regulating Device; Elihu Thomson, Lynn, Mass. Application filed March 30, 1887. The invention consists of a device employing a closed conducting circuit of low resistance and high self-induction, in which rapidly alternating currents are produced by an alternating current coil or an alternating magnetic field with a core of iron, which forms the core of the same alternating current coil or of another coil in which alternating currents flow in the two parts; that is, the magnetic core and that forming the closed conducting circuit in which alternating induced currents are set up, being combined with one another in such a manner that a change in the relation of the closed induced circuit, with relation to its inducing agent shall be accompanied by a simultaneous change in the magnetic relation of the core to its alternating current coil. The object is to provide a device adapted for use on alternating current circuits either as a motive device to serve the purposes of an electro-



377,110. TELEGRAPH INSTRUMENT.

magnet, or as a regulating device to vary or control the counter electromotive force or reaction at a point on an alternating circuit.

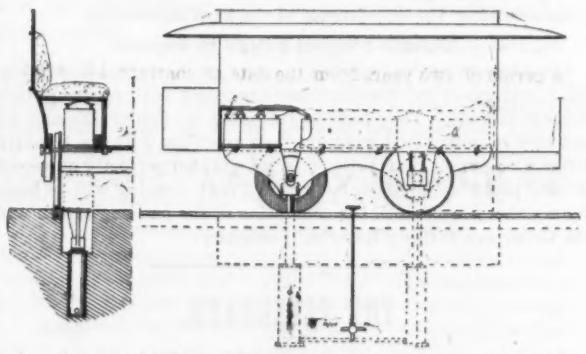
377,218. Electric Belt; George W. and Perry C. Totman, Cassadaga, N. Y. Application filed June 18, 1887. The belt is a chain composed of links or cells coupled together in series, the links of opposite polarity or the plates of the cells being held by a non-conducting binder of electricity. A supplemental metallic binder embraces and forms a shield for the first-named binder.

(1) 377,229. Electric Locomotive; (2) 377,230. Electric Motor; Edward M. Bentley, New York, N. Y. Applications filed July 30, 1887, and Aug. 4, 1887, respectively. (1) A motor is geared to an axle of the locomotive and so fulcrumed thereon that its centre of gravity falls on one side of the axle. A suitable counterbalance is provided. (2) An electric motor and the mechanism which it drives are connected by countershaft about which the motor is spring-centred. See illustration.

377,237. Plug Switch for Telephone and Telegraph Circuits; George H. Cole, Atlanta, Ga. Application filed June 30, 1887. A metal tube adapted to enter a switch-board has a tubular insulating lining arranged within one end. Through the insulating lining passes a headed pin having insulating and metallic washers. At the other end of the tube a hollow plug is inserted. This plug makes metallic connection between the pin and the tube.

377,256. Electric Annunciator; John W. Hoffmann, Pullman, Ill. Application filed March 24, 1887. The invention relates to the class of annunciators in which an index hand is released by an electro-magnet, the release serving to indicate that a call has been made. The improvements are concerned with means for preventing the displacement of the index hand, as by the jolting of a car, the annunciator being specially designed for use on railway cars.

377,255. Regulation of Electric Motors; Daniel Higham, Philadelphia, Pa., Assignor to the Higham Electric Motor Co., same place. Application filed Feb. 21, 1887. The field-magnet has shunt coils and series coils opposed to each other, and a short circuit around the series coils. A speed governor



377,107. ELECTRIC RAILWAY.

operates a contact for the short circuit to vary the magnetic effect of the field-magnet coils.

377,319. Electric Motor; Charles T. Mason, Sr., Sumter, S. C., Assignor to the Maryland Electric Motor Manufacturing Co., Baltimore City. Application filed Dec. 24, 1886. A divided axle for electric railway trucks, the two axle halves being bolted to an insulating block through lugs that alternate in position on opposite sides of the block.

377,340. Galvanic Battery; David Urquhart, Westminster, and Benjamin Nicholson, South Norwood Park, County of Surrey, Assignors to the New Portable Electric Lamp and Power Syndicate Company (Limited), London, England. Application filed Sept. 21, 1887. Patented in England, May 23, 1887, No. 7,506. The negative element of the battery is composed of or carries peroxide of silver. The positive elements are of S shape, and the negative elements are arranged one in each loop of the S. The latter are all attached to a disc covering the vessel, so that by removing the cover the negative elements can be readily taken out for regeneration.

377,344. Railway Telegraph; Charles H. Williams, Cave City, Ky. Application filed June 2, 1886. A partial circuit including signaling instruments is carried on the car, and this is combined with a circuit outside the car and with a repeater joined to a main line circuit.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.